1989

The Role Of Attitudes And Beliefs In Personal Computer Utilization

Ronald Lawrence Thompson

THE ROLE OF ATTITUDES AND BELIEFS IN PERSONAL COMPUTER UTILIZATION

by

Ronald L. Thompson

School of Business Administration

Submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Ontario
September 1988

ISBN 0-315-49329-1

ABSTRACT

A two-phased study investigating the role of attitudes and beliefs in the use of personal computers was conducted in 9 organizations. During the first phase a questionnaire was administered to 278 knowledge workers within one organization. The measurement scale items were tested and revised slightly, and the research model tested also. In the second phase, the revised questionnaire was administered to 364 knowledge workers (80% gross response rate) in 8 diverse organizations. The measures and research model were tested using Partial Least Squares. Nine of the eleven hypothesized relations were supported statistically, and 38% of the variance was explained in the major dependent variable, utilization.

The general findings were:

1. There were three distinct components of attitudes and beliefs identified which relate to the utilization of personal computers, including; (1) job-related expectations of use, (2) correspondence between job tasks and personal computer use, and (3) general beliefs about personal computer use (difficulty, time requirements.)

2. Of the different attitude components, only correspondence had a significant influence on personal computer utilization.

3. Experience with personal computers strongly influenced all three components of attitudes and beliefs, and also influenced the utilization of personal computers directly.

4. Management support had a positive influence on expectations and general beliefs about personal computer use, but there was no direct relation between management support and utilization.

5. A strong relation was observed between the utilization of personal computers and related aspects of performance.

The implications of the findings for practitioners are that organizations wishing to increase the amount and effectiveness of personal computer use by knowledge workers should stress the potential correspondence between the personal computer environment and current job tasks. As the experience level with personal computers increases, further applications for job tasks are discovered and utilization increases. The cycle repeats itself, with increased use and experience leading to greater appreciation of the correspondence between job tasks and the personal computer environment. For researchers, the results confirmed the need to examine separate components of attitudes and beliefs within the context of system utilization. Also, the measures which were developed and tested are appropriate for future research.

ACKNOWLEDGEMENTS

It would be impossible to acknowledge the assistance of everyone who has helped me in this endeavor. There are several individuals, however, who deserve recognition and to whom I wish to express my sincere gratitude.

Chris Higgins has acted both formally as an advisor and informally as a friend. He always knew when to encourage, when to criticize, and when to push for completion of this project. Without him, I might still be searching for a suitable topic. I am deeply indebted to Jane Howell, Sid Huff and Peter Newson. Their guidance and efforts have been invaluable throughout my years at Western, in addition to their assistance with the dissertation. I also wish to thank Don Barclay for helping me develop a further understanding of research and research methodology, and Doug Baer for his valuable and insightful comments concerning the dissertation.

Finally, I want to thank my wife Jennifer for her never ending and untiring support. She never stopped believing in my ability to finish, and her assistance included everything from theoretcal discussions to proof reading draft copies. Without her, it wouldn't have happened.

Thank you, everyone.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1 - INTRODUCTION

1.1 Introduction to the Topic

Most organizations continue to adopt personal computers and related technology to assist employees in their work. Estimates based on historical trends suggest that by 1990 there may be as many as 200 million 'intelligent workstations' installed in offices worldwide (Strassman, 1985).

The adoption of personal computers generally begins with clerical staff, where use is often mandatory and efficiency improvements (through the use of word processing software, electronic communications and related technology) are readily demonstrated. The adoption of personal computer technology by knowledge workers, however, has been more difficult than for clerical staff (Bowen, 1986). In environments where use is optional, the rates of adoption vary substantially. Within the population of users, there also exists a wide variance in terms of effectiveness of utilization.

Lee (1986) suggested that relatively little attention has been paid to the linkage between the availability of information systems technology and its use by professional workers and managers. The situation facing one major organization illustrates this point. Substantial resources were expended to make personal computer technology available to their 1500 knowledge workers. Additional funds were used to assist employees in purchasing personal systems for home use, and close to 600 individuals took advantage of the employee purchase program. The difficulty, however, was that providing access to the technology did not automatically result in increased utilization. As the Senior Vice President of Administration stated (paraphrased):

> "We don't know how much the personal computers are being used or what they are being used for. We don't know which employees are using the technology and which are not. We had hoped that obtaining the systems would lead to more effective and creative approaches being employed in all aspects of our business, but at this point we can't show any hard numbers to justify the money spent. More importantly, we really don't know where to focus our attention to make the most of the technology we already have in place."

Many other organizations are in a similar situation. Having invested substantial resources (or contemplating large investments) in personal computer technology, there is no guarantee the technology will be used widely or effectively. The key point is that there are many factors which influence the utilization of personal computers by knowledge workers. Providing ready access to the technology is one such factor. There are others, such as attitudes toward using personal computers, which are also important. Organizations need to determine what types and levels of support to provide for the use of personal computers. To do this, it is important for the policy makers to understand the relative influence of different factors (including usage-related components of attitudes) which influence the optional use of personal computers.

For researchers wishing to help practitioners develop useful policies and strategies for the support of personal computer use, it is equally important to obtain a deeper understanding of the factors which influence the use of personal computers. Previous studies have demonstrated the importance of attitudes and beliefs(1) in influencing the utilization of information systems (Adams, 1975; Schultz and Slevin, 1975; Schewe, 1976; Lucas, 1978; Robey, 1979; Swanson, 1982; Jobber and Watts, 1986; Pavri, 1988).

Results have not been conclusive, however, and several Management Information Systems (MIS) researchers have identified a need for additional work focusing on the attitude construct. As Lucas (1978) stated:

> "More sophisticated studies should include different attributes of attitudes and try to determine the relative importance of the attributes in influencing behavior toward a system or model".

More specifically, a need exists for the identification of components of attitudes and beliefs which relate to system usage, and determination of the relative strengths of relations involving these dimensions (Lucas, 1978; Robey, 1979; Swanson, 1982; Pavri, 1988).

---

(1) A discussion of the definitions adopted for the terms attitude and belief is provided in the following chapter. In general, attitudes are feelings an individual holds toward a given object or issue, which include some connotation of like or dislike. Beliefs are the knowledge or understanding an individual has about a given object or issue, with no emotional (like/dislike) component. Previous MIS researchers have generally used the term attitudes to include both attitudes and beliefs, as defined here.

The underlying logic of the stream of research relating attitudes and the use of information systems is that:

1. Under certain circumstances, attitudes influence behaviors.

2. Under certain circumstances, attitudes can be changed.

3. It therefore follows that, under certain circumstances, behaviors can be changed by changing attitudes.

Applying this to personal computer use by knowledge workers implies that the utilization of personal computers can be influenced by changing attitudes toward using personal computers. If attitudes have only a small influence on utlization, however, then efforts to change utilization patterns by changing attitudes will also have little influence. Similarily, if only certain components of attitudes have a substantive influence, then efforts to change behaviors through attitudes should focus on these specific components of attitudes.

Researchers have provided recommendations for managing the use of personal computers by professional staff and knowledge workers. Some of these recommendation were drawn from survey results and/or personal experience (Alavi, 1985-a & 1985-b; Alavi and Weiss, 1985-86; Gerrity and Rockart, 1984; Guimaraes and Ramanujam, 1986; Lee, 1986), while others followed from the development of conceptual 'life cycle' or 'growth stages' models (Henderson and Treacy, 1986; Huff, Munro and Martin, 1988).

Most of the authors either implicitly or explicitly include considerations of the attitudes of individual users (knowledge workers) when developing their recommendations. No research was located, however, which examined the relative influence of separate components of attitudes and beliefs on the use of personal computers. By doing so a better understanding would be provided of the role of attitudes and beliefs in personal computer utilization, which would also provide a basis for more specific recommendations relating to the management of personal computer use.

The research reported here focused on the use of personal computer systems by knowledge workers in optional use environments. The study included both stand alone units and those operating as 'intelligent workstations' (connected to other computer systems). The primary focus for the investigation was to identify the relevant components of attitudes and beliefs which could influence personal computer utilization, and then develop and test a model of utilization which incorporated these components. The unit of analysis was the individual.

1.2 Research Questions

The primary objective of this research was to measure the relative strength of relations between different components of attitudes and the utilization of personal computers. The purpose was to identify those attitudes and beliefs which, if influenced by management, would provide the greatest influence on individual utilization. The specific research questions which needed to be addressed to achieve this objective were:

1. What important components of attitudes and beliefs influence the utilization of personal computers by knowledge workers?

2. What is the relative strength of the relations involving each of the attitude components?

3. How strong is the influence of attitudes and beliefs in relation to other factors such as previous personal computer experience and management support for personal computer use?

It should be noted that this research was <u>not</u> designed to explain the maximum amount of variance in the utilization construct, which has been the focus of some previous studies (Floyd, 1986; Pavri, 1988). As stated earlier, the objective was to measure the relative influence of different attitudes and beliefs on utilization. However, if a sufficient amount of the variance in utilization was not explained, little confidence could be placed in the research model or the findings. Hence the strategy adopted was to develop a parsimonious model involving components of attitudes and related factors hypothesized or shown previously to have a strong influence on personal computer utilization. For this reason some factors which may influence utilization to a lesser degree were excluded.

For example, Azjen and Fishbein (1977) suggested that group norms influence intentions and behaviors, leading to the hypothesis that group norms influence system utilization. Pavri (1988) also found a statistically significant, but relatively weak relationship between group norms and personal computer utilization. This implies that the inclusion of group norms might increase the explanatory power slightly, but not substantively. For this reason group norms were not included in the conceptual model.

1.3 Research Approach

The first phase of the research involved identifying dimensions of system-usage related attitudes and beliefs. These included 1) job-related expectations of use, 2) the degree of correspondence between job tasks and the personal computer environment, and 3) beliefs about personal computer usage. Two additional factors shown previously to influence personal computer use directly (as well as indirectly through attitudes and beliefs) were personal computer experience and management support for personal computer utilization.

The relationships (and potential relationships) among these these five factors (constructs) were examined through reference to previous research. Research hypotheses were generated, and the constructs and corresponding relations were incorporated into a causal model of personal computer utilization.

To extend the model beyond the utilization construct, related aspects of performance were identified and also included. It was hypothesized that utilization would influence the perception of job-related performance. Appropriate measures were developed for each of the constructs, with reference to previously tested measurement scales wherever possible.

A pilot study was conducted in a single organization to test the measures developed for the research. Data were collected from 278 knowledge workers from nine geographically separate divisions. The reliability and validity of the measurement scales (and individual items) were tested. The research hypotheses and conceptual model were also tested with the pilot study data.

The measures were revised slightly to reflect the findings from the pilot study, and the revised questionnaire administered to knowledge workers in eight additional organizations. The technique for data collection was a modified version of the Total Design Method developed by Dillman (1978). The primary modification was the use of DISKette-based Questionnaires (DISKQ), developed by Higgins, Dimnik and Greenwood (1987). The questionnaires were loaded onto computer diskettes, and the respondents completed them interactively through the use of personal computers.

The data for both the pilot study (first phase) and the primary study (second phase) were analyzed using Partial Least Squares (PLS). PLS is one of a group of analysis techniques termed 'second generation' by Fornell (1982), which allow the simultaneous testing of the measurement model (indicators) and the structural relationships (hypotheses). Second generation analysis techniques are ideal for social science research, as they are designed specifically to handle theoretical models involving multiple latent variables (constructs), each of which is measured by multiple manifest (observable) variables (indicators). This was the situation for the current research study, which is often encountered in social science research.

1.4 Outline

This chapter introduced the topic of investigation and discussed the need for research. The research questions were presented, as well as the research method that was employed. The second chapter provides a review of relevant background literature. Specific references to personal computing and end user computing are examined, as well as definitions of attitudes and beliefs and general theories of attitudes and behaviors. Research hypotheses are developed through an examination of factors influencing utilization, both directly and indirectly. The relation between utilization and performance is also discussed, and the conceptual model presented. The chapter concludes with a brief look at additional factors which may influence utilization and the reasons they were not included in this study.

The overall research design is presented in Chapter three, including a description of the site selection and discussions of the procedure used, the data collection technique and data analysis methodology. Specific reference is made to testing the measurement model (relations between indicators and constructs) and the structural model (relations between constructs). Chapter four provides a description of the pilot study (first phase), including the respondents, the organization, the data collection protocol, and the data analysis results. The measures are tested for reliability and validity, and the structural model (hypotheses) tested as well.

The results from the primary study (second phase) are presented in chapter five. The measures and relations between constructs are tested using Partial Least Squares (PLS). Chapter six provides the conclusions and implications drawn from the study, as well as a discussion of the potential for future research.

CHAPTER 2 - LITERATURE REVIEW AND MODEL DEVELOPMENT

This chapter reviews literature pertinent to the description of the topic and the development of the conceptual model. It begins with a discussion of personal computing and end user computing (EUC). The importance of understanding the role of attitudes and beliefs is illustrated through reference to literature dealing with the management of EUC. This is followed by a look at alternative definitions for attitudes and behaviors, and a discussion of attitudes and system utilization. Next, research hypotheses are generated through reference to studies which investigate factors hypothesized to directly influence the utilization of information systems. These factors include personal computer experience, management support for personal computer use, job-related expectations of use, perceptions of the correspondence between job tasks and personal computer use, and beliefs about personal computer usage (difficulty, etc).

In addition to the direct relations hypothesized, indirect effects of experience and management support through the different components of attitudes and beliefs are proposed and examined. Next, the relation between utilization and performance is explored. The conceptual model is then presented. The final section of the chapter examines additional factors which have been proposed as influencing the utilization of information systems, and provides reasons for not including them in this research.

2.1 The Importance of Attitudes for Managing Personal Computing

Research dealing directly with the use of personal computers is somewhat limited, while the more general topics of end user computing (EUC) and information system utilization have received considerable attention. The investigation of personal computer use has not been extensive enough to provide a solid base for this research, and hence studies involving EUC and the management of EUC are included.

The use of mainframe computer-based systems are also employed in the development of the conceptual model. W. Beatty (1986) used a similar approach in his development and testing of a conceptual model involving the satisfaction of personal computer users, and his results were similar to those obtained from studies involving mainframe environments (W. Beatty, 1986). In this respect his findings provide support for the validity of using literature examining EUC and mainframe information systems as a basis for this research.

Within the broad areas of personal computer use and end user computing, the activities performed and skill levels of users are quite diverse. Several classification schemes for end users have been proposed (McLean, 1979; Rockart and Flannery, 1983; Davis, 1986). The focus of this study is on individuals who would be categorized as DP amateurs by McLean (1979), command-level users and end-user programmers by Rockart and Flannery (1983), or autonomous (and possibly hybrid) users by Davis (1986). The characteristics of this class of users were described by

Amoroso (1986-b) and include individuals who have a relatively low level of computing skills, program applications for personal or limited use, request support rather than deliver it, locate in a functional area, and train extensively for a small number of software packages.

Although few studies have developed or tested theory relating to the use of personal computers, numerous studies investigating end user computing and personal computing have been conducted. Many of these have provided descriptive information relating the level of use, the software employed, and the types of applications commonly encountered. Some studies have adopted the perspective of the individual or department charged with the responsibility of managing data processing (DP) and/or end user computing (Leitheiser and Wetherbe, 1984-a; Rivard and Huff, 1984; Alavi, 1985-a; Sumner, 1985). Others have examined the situation from the viewpoint of the users (or end users) (Benson, 1983; Rockart and Flannery, 1983; Brancheau, Vogel and Wetherbe, 1985; Lee, 1986), while some have focused specifically on the use of 'executive' systems (Rockart and Treacy, 1982; DeLong and Rockart, 1984; Moore, 1986).

These studies have provided valuable insights into trends and usage patterns. The ultimate objective of research investigating end user computing and the use of personal computers, however, is to help manage the use of computer systems by non-technically trained individuals. For this reason, researchers have also offered recommendations dealing with specific managerial issues. Keen and Woodman (1984) focused on the proliferation of personal computer systems. They suggested that standards be established for the acquisition of hardware and software, and that responsibilities be clearly defined for the central data processing (DP) staff and users.

Alavi and Weiss (1985-86) focused their efforts on the risks associated with user developed applications (UDA), and Alavi (1985-b) provided recommendations for addressing quality issues of UDA. Rivard and Huff (1984) also provided recommendations for UDA; their suggestions tended to be broader in focus, and stressed the importance of defining UDA success within the context of the organization before proceeding.

Other researchers have looked at the primary responsibilities and critical success factors for the information center (IC) managers or DP managers responsible for end user computing. Sumner (1985) conducted 13 case studies of Information Centers (IC) which had been in operation at least two years. The IC managers were asked to identify their primary responsibilities. The top five listed were: 1) training, 2) consulting, 3) technical and operations support, 4) hotline, and 5) management of data. Brancheau, Vogel and Wetherbe (1985) adopted the perspective of the manager of the information center, and developed a list of critical success factors for IC's. These were based on a survey of IC users, and focused on staff competence, leadership in the use of technology, the provision of core services, and adopting a service approach.

Additional research has investigated EUC management practices, primarily from the IS management perspective. Rockart and Flannery (1983) identified two types of structure (traditional time-sharing management and centralized end user computing support), but found little to report in terms of process management. Guimaraes and Ramanujam (1986) examined selected programs and policies for EUC, and found a general trend toward increased involvement by IS departments.

The previously discussed recommendations tend to deal with specific issues relating to end user computing. A few authors have also provided general approaches for managing EUC.

Rockart and Flannery (1983) felt there were three major areas requiring attention (end user strategy, support of end users by the IS organization, and control of EUC). Gerrity and Rockart (1984) identified three general approaches which they felt predominated the environment (monopolist, laissez-faire, and information center), and detailed the perceived pros and cons of each. They then provided an alternative approach which they termed 'a managed free economy', and recommended five critical attributes of the approach:

1. a stated end user strategy,
2. a user/IS working partnership,
3. an active targetting of critical end user systems and applications,
4. an integrated end user support organization, and
5. an emphasis on education throughout the organization.

Henderson and Treacy (1986) took a different approach to the topic of managing EUC. Their focus was more on the process management referred to by Rockart and Flannery (1983). Henderson and Treacy (1986) suggested that the introduction of EUC into an organization follows a life cycle, and that different approaches are better at different points along the organizational learning curve. They also suggest that there are four fundamental issues which need to be addressed: 1) the support infrastructure, 2) the technological infrastructure, 3) the data infrastructure, and 4) evaluation/justification and planning. One major contribution of this work was the introduction of a dynamic component to the management issue.

Huff, Munro and Martin (1988) also proposed a growth model of end user computing. They adopted the maturity of applications developed by users as the prime indicator of the stage of advancement of EUC in an organization. The resulting model was developed through a review of literature, field studies, and personal experience, and was validated to some extent by five independent IC managers.

The stages of application maturity identified by Huff Munro and Martin (1988) included 1) isolation, 2) standalone, 3) manual integration, 4) automated integration, and 5) distributed integration. The authors suggest that the process will be more cyclical than sequential, as new individuals become users and begin at the isolation stage. They also suggest a similarity or correspondence between the stages of the model and the organizational learning which takes place as users advance in their abilities to use technology.

An additional contribution of the work of Huff, Munro and Martin (1988) is the identification of 'growth processes', or processes which affect the environment for EUC. The authors suggest that many (most) of these processes are under the control of management, and can be managed to facilitate movement through the five stages of growth. These include:

1. focus of the IC operations,
2. planning and control,
3. IC support activities,
4. training provided by IC,
5. IC staff's attitudes and feelings, and
6. end users' attitudes and feelings.

One of the major contributions of the models suggested by Henderson and Treacy (1986) and Huff, Munro and Martin (1988) was the introduction of a time element. At both the organizational and individual levels, this implies that learning takes place, and that the type, quality and quantity of support required will change over time.

Many of the studies which were examined either implicitly or explicitly included attitudes as a consideration for the management of end user computing and personal computer use. For example, Alavi (1985-a) asked information systems (IS) managers several questions relating to their attitudes toward EUC. The responses tended to be quite favourable, however the questions were of a general nature and at a relatively high level ('EUC is beneficial to my organization'). Huff, Munro and Martin (1988) suggested that the attitudes of users are one of the processes which affect the growth of EUC and personal computer use within an organization. Upon closer examination, the attitudes they refer to are the attitudes of the end users toward EUC and the information center. Again the attitudes are conceptualized at a relatively high level, which is consistent with the remainder of the framework developed by Huff, Munro and Martin (1988).

Although the attitudes of the users have been included to some extent in many of the studies examined, the potential implications of individual attitudes for managing EUC and personal computer use do not appear to have been explored in detail. This is not surprising, given the recent appearance of personal computer systems and the rapid development of end user computing.

To address the role of individual attitudes in the management of personal computer use and end user computing, a number of issues need to be addressed. First, what are the objectives of the management function? Some authors have suggested or implied a number of basic objectives, two of which are 1) to encourage the adoption of personal computer use or end user computing by individuals where potential benefits exist, and 2) to maintain a balance between fostering creativity and more sophisticated use to reap potential benefits, while maintaining sufficient coordination and control to avoid potential problems (Keen and Woodman, 1984; Gerrity and Rockart, 1984; Alavi and Weiss, 1985-86; Guimaraes and Ramanujam, 1986; Henderson and Treacy, 1986; Huff, Munro and Martin, 1988).

Given these objectives, it would be beneficial for the individuals (or groups) charged with this management responsibility to have knowledge of the attitudes of users (and potential users) towards specific, usage-related objects and issues. It would also be beneficial to know how strong an influence the different attitudes have on actual behavior (utilization), and an understanding of the relationship between attitudes and behaviors. For example, Henderson and Treacy (1986) suggest that an 'implementation perspective' should be taken early in the adoption of end user computing. The overall objective of this initial phase is to increase the use of information technology and enhance user satisfaction. Their major recommendations for this phase are the use of centralized help centers, with minimal control mechanisms and the adoption of an innovation orientation. They also suggest that part of the strategy at this point is to build an enthusiasm for change through education.

To take these recommendations one step further, it would be necessary to answer questions such as 'What form should the education take? Should the emphasis be on potential career development, technical skills, organizational change, or the applicability of technology to individual job tasks?'. It would also be necessary to know what type of assistance the help centers should provide, and what control mechanisms should be instituted.

A clearer understanding of the relationship between attitudes of individuals and behaviors is essential to answer these and related questions. For example, if research shows that the perception of the degree of correspondence between an individual's job tasks and the computer environment available to them has a very strong influence on their actual use of computer systems, then education focusing on potential applications for individual jobs could change beliefs about the degree of correspondence and hence change the actual utilization. If, on the other hand, there is no relationship between the perception of correspondence and utilization, educational efforts aimed at changing the perception of correspondence will have no influence on utilization.

The point of this discussion is that many of the recommendations put forward for the management of personal computer use and end user computing have been based on existing management practices and previous research conducted at a relatively high level. To provide more specific recommendations, one important consideration is the role of individual attitudes toward related aspects of system utilization.

2.2 Attitudes and Beliefs

Since attitudes and beliefs play a critical role in this research, it is necessary to clearly define the meanings attached to these terms and to identify the perspective adopted. Previous MIS studies involving attitudes and system utilization have not always defined what was meant by attitudes, making comparisons between research studies somewhat difficult.

A number of viewpoints or perspectives for attitudes have been proposed. Two fairly common ones are the tripartite view (Lutz, 1976) and the unidimensional view (Bem, 1970; Oskamp, 1977; Triandis, 1980). Under the tripartite perspective, attitudes are viewed as consisting of three parts:

1. cognition (the knowledge or idea)
2. affect (the emotion that charges the idea)
3. conation (the action taken)

According to the tripartite view, all three components are integral parts of any attitude. Also, the three components are expected to exhibit a basic consistency in terms of favorability or unfavorability toward the behavior. For example, if an individual believes that computers will provide positive benefits (cognition), then he or she will be expected to like using computers (affect), and will most likely use them (conation).

Under the unidimensional view, the three parts (cognition, affect and conation) are separated into:

1. beliefs (cognition)
2. attitudes (affect)
3. intentions and behaviors (conation)

This view suggests that a causal flow exists, as illustrated below.

Beliefs ------> Attitudes ------> Intentions and Behaviors

To use the example from above, if someone holds positive beliefs about the benefits of computer use for their job, this will cause them to have positive attitudes toward using a computer for their job, which will in turn cause them to have positive intentions about using a computer for their job and they will tend to use a computer on their job.

To simplify the discussion on attitudes and beliefs, it is possible to view attitudes as normative orientations, while beliefs are claims which can be inspected with respect to 'facts'. Concerning the model presented above, not all researchers agree that attitudes influence behaviors; some argue that the opposite is also possible.

When it comes to measuring beliefs and attitudes, Burnkrant and Page (1982) assert that:

> "any measure of attitudes toward behavior, whether based on beliefs or direct ratings of affect, may be regarded as alternative measures of the same unidimensional construct".

In other words, they suggest that it is more important to focus on the object of the attitudes, rather than distinguishing between attitudes and beliefs (or cognition and affect). Robey (1979) argued in favour of this approach in his study of attitudes and their influence on the utilization of an information system.

Fishbein (1979) suggested that a person's attitude toward some object or behavior is the sum (or totality) of numerous beliefs. That is, a person may hold some positive attitudes and some negative attitudes about the same object or behavior, simultaneously. Fishbein (1979) also suggested that the various belief components can be summed to obtain an 'overall' measure of the attitude, i.e.:

$$A = \sum_{i=1}^{n} b_i e_i$$

where

A = attitude toward performing the behavior

b = belief that performing B leads to consequence i

e = the person's evaluation of consequence i

n = the number of beliefs

Fishbein (1979) also argued that it is necessary to distinguish between attitudes toward the object (personal computers) and attitudes toward the behavior (using personal computers). He suggested that attitudes toward the behavior were important in predicting the behavior, while attitudes toward the object were not.

The approach advocated by Fishbein (1979) involves obtaining an overall measure of attitudes (and beliefs) at a very high level. This overall measure is then used to determine what influence (if any) the attitude has on the related behavior. This was the approach adopted by Pavri (1988), who observed a strong, positive relation between attitudes toward using personal computers and personal computer utilization.

At a more detailed level, however, it would be beneficial to identify different components of attitudes (and beliefs), and to measure the relative strength of the influence of each component. This was the suggestion put forward by Lucas (1978), Swanson (1982), and Pavri (1988). If the measurement is attempted at too low a level, however, difficulties may arise in actual measurement (such as empirically differentiating between the various components). For this reason it is necessary to choose a level of conceptualization which allows differentiation of the attitude components, but which can also be adequately measured (through the development of reliable and valid measures).

Pavri (1988) agreed with Fishbein (1979) and Burnkrant and Page (1982) that, although there may be theoretical justification for separating attitudes and beliefs, when it comes to measurement they should be treated as the same construct. For this reason, it is advisable to measure beliefs, rather than attempting to measure both the cognitive and affective components of attitudes (Goodhue, 1986).

2.3 Attitudes and System Utilization

This section looks at studies involving attitudes and behaviors within the context of using information systems.

Over a decade ago, Lucas (1975) conducted a study into performance and the use of an information system. To provide more structure for subsequent work, he developed a descriptive model, which he later generalized to include 'implementation success' (Lucas, 1978) rather than focusing on utilization and performance (see Figure 1 on page 26).

To test aspects of the model, Lucas (1978) conducted a series of nine research studies. Not all of the studies addressed all relations from the model, but Lucas (1978) concluded that there was at least some support for five of the hypothesized relations, while the results for the other two were inconclusive. With respect to attitudes, he found support for the proposition that attitudes and perceptions are related to implementation success. Lucas (1978) grouped attitudes and perceptions together as a single construct. However, he acknowledged that:

> "More sophisticated studies should include different attributes of attitudes and try to determine the relative importance of the attributes in influencing behavior toward a system or model".

Goodhue (1986) argued that the successful use of attitudes in information systems research is dependent on the development of a convincing theoretical model of the causal chain from systems to value (performance), and the place of attitudes in that chain. He based his observations and conclusions on an extensive review of literature which employed IS attitudes.

One conclusion Goodhue (1986) reached was that there are two distinct ways in which attitudes might fit into the chain between systems and performance. The first is to view attitudes as surrogates for value itself, or for some instrumental variable in a process leading to value. A second approach is to view positive attitudes as a prerequisite to

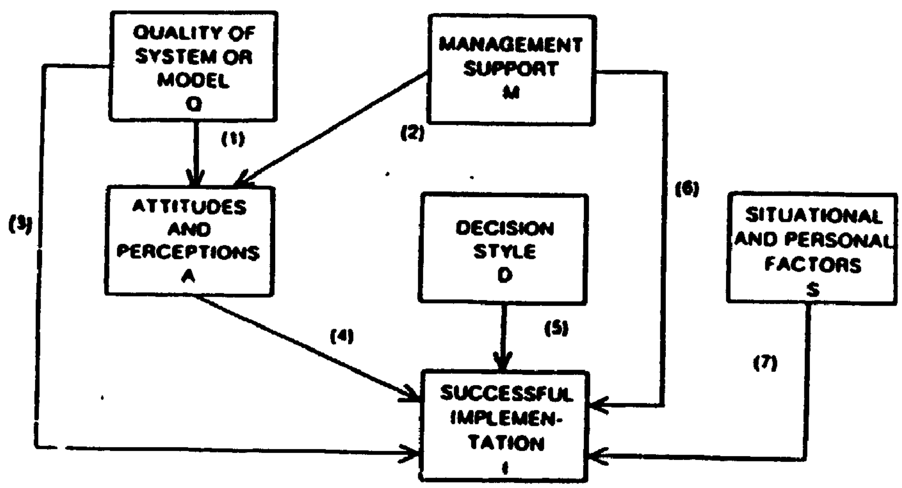


Figure 1. Descriptive Model of Implementation: Lucas, 1978

optional use of a system, and thus important in their own right. The second perspective was the one adopted here.

The relation between attitudes and utilization is by no means clear, although most studies have found a positive relation between the two. Adams (1975) interviewed 75 managers in ten companies in his examination of attitudes toward computers and information systems. He concluded that attitudes were quite favorable, and that a relation existed between attitudes and direct use. His definition of direct use of a computer in the respondents' work was that they received computer reports regularly.

Schultz and Slevin (1975) compiled a series of statements from the anecdotal literature concerning implementation. The statements were then converted to a Likert type questionnaire designed to measure the concerns of users of MIS, management science, and operations research techniques. The primary objective was to develop a reliable measure of user attitudes.

Schultz and Slevin (1975) conducted a pilot study, obtaining 106 responses. Factor analysis was used, and 57 items were observed to have loadings greater than .3 on a total of 7 factors. In their initial use of the instrument, Schultz and Slevin (1975) found significant correlations between several of the factors and perceptions of system value. No measures of actual use were obtained, however.

Robey (1979) chose to use the questionnaire developed by Schultz and Slevin (1975) to examine the relation between attitudes and use in a study of salespeople. He decided to focus on the object of the attitudes (such as control over one's job) rather than distinguishing between perceptions, beliefs and affective responses. The results obtained generally supported the proposition that user attitudes (or perceptions) were related to system use, although the original factor structure developed by Schultz and Slevin (1975) was not supported.

Schewe (1976) presented a theoretical model relating attitudes and system usage, which he tested empirically. He differentiated between attitudes and beliefs, adopting the unidimensional view of attitudes discussed earlier (Bem, 1970). A 5-point bipolar scale was used to collect data from 79 users on 48 variables. The results Schewe (1976) obtained were somewhat inconsistent, and he concluded that attitudes did not appear to have any real influence on behavior. In his review of studies which measured user attitudes in MIS research, Swanson (1982) suggested that the apparently inconsistent results obtained by Schewe (1976) could be due in part to different definitions and measures of the attitude construct.

Swanson (1982) also identified two major perspectives for examining attitudes. The first was concerned with MIS design and implementation (Ginzberg, 1981), while the second focused on information (Larcker and Lessig, 1980; O'Reilly, 1982). Reinforcing the point made earlier by Lucas (1978), he stated that much of the research on MIS user attitudes approached the problem from broad perspectives, with many aspects of attitude explored. In other words, attitudes were being treated, and measured, at a relatively high level.

In fact, Swanson argued that the dimensions of attitudes measured by Schewe were actually attitudes, and hence the reseults did show that MIS usage covaried with judgements about MIS 'dimensions'. He suggested that the results were therefore consistent with those of other researchers, contrary to Schewe's interpretation. Further, he suggested that new construct(s) should be introduced which relate more closely to user behavior (utilization).

Pavri (1988) suggested four possible reasons for the conflicting and/or inconsistent results from studies involving attitudes and system utilization. These included:

1. varying concepts and definitions;
2. lack of specificity in the attitude measure;
3. varying measurement methods (single-item, etc.); and
4. different measures of the behavior (utilization).

Another factor stressed by Fishbein (1979) was the importance of measuring attitudes toward a behavior (rather than toward an object) if the objective is to predict the behavior. That is, measuring attitudes toward personal computers will provide little assistance in predicting the utilization of personal computers, while measuring attitudes toward _using_ personal computers will aid in prediction. This proposition was tested and supported by Fazio and Zanna (1981) in their study of the use of birth control pills by women.

Building from these studies, the perspective toward measuring attitudes adopted for this research was:

1. Measuring beliefs (unidimensional view) or the cognitive component of attitudes (tripartite view) is sufficient for measuring attitudes.

2. It is important to measure attitudes toward using personal computers, not attitudes toward personal computers.

3. Usage-related components of attitudes toward using personal computers should be identified and measured.

2.4 Factors Influencing Utilization Directly

The previous four sections provided background information concerning end user computing and the use of personal computers, definitions of attitudes and beliefs, general theories of attitude change, and attitudes and system utilization. The next three sections deal specifically with relationships used in the development of the research hypotheses and conceptual model employed in this research.

The development of the model is based on studies and theoretical work involving the use of mainframe-based information systems, as well as studies focusing on the use of personal computers. The reference to mainframe-based systems is justified on the basis of the similarity of the topics and the lack of strong theoretical work in the area of personal computer utilization. As mentioned previously, W. Beatty (1986) used a similar approach in the development and testing of a model involving the satisfaction of personal computer users. The results he obtained were consistent with those from previous studies involving mainframe systems, suggesting that this is a valid approach.

Drawing on the work of previous researchers, three factors were found which had been shown to influence the utilization of information systems directly. These were previous computer experience, management support, and attitudes toward using the information system. Additional work (Lucas, 1978; Swanson, 1982) suggested that the attitude construct could be divided into components, and each of the components examined separately as a distinct factor influencing utilization. Three such components were identified, once more through reference to previous research. These were the job-related expectations of use (Robey, 1979; C. Beatty, 1986), the correspondence between job tasks and the IS environment (Goodhue, 1986; Floyd, 1986), and beliefs about personal computer use (Howard, 1985). These five factors and their relations with personal computer utilization are discussed in turn.

2.4.1 EXPERIENCE

Amoroso (1986-a) developed and tested a conceptual model of 'end user developed application effectiveness'. Effectiveness was defined and measured in terms of system utilization and user satisfaction. One of the factors hypothesized to influence effectiveness was the IS/EUC experience of the user. Interviews were conducted with managers in 40 diverse organizations, and a positive correlation was observed between previous experience and system utilization.

Kaspar and Cerveny (1985) conducted a laboratory study involving 96 MBA students. As part of the experiment, students were asked to indicate their previous experience with computers. They were then given a task to perform, and were given the options of using command level procedures available with an extended version of a decision support system (DSS) software package, or developing their own programs with a procedural software language. The study involved a series of weekly decisions over an 8 week period, and the results indicated that in the earlier stages of the experiment the previous computer experience influenced the choice of and use of the DSS package. The results indicated that those with previous experience tended to use the package more extensively.

Another study, conducted by Lee (1986), found a positive correlation between previous computer experience and the use of personal computer systems. More specifically, Lee (1986) found positive correlations between prior experience with computers and the number of different applications used, as well as between prior experience and the number of hours spent per week using personal computers. The respondents included 311 managers and professional staff from 12 organizations.

These studies imply a direct relation between computer experience and use. This suggests that the experience that the user has with information systems in general, and personal computer systems in particular, will influence the use of personal computers. This gives rise to the first hypothesis:

H1: The greater the level of Personal Computer Experience, the greater the Utilization of Personal Computers.

2.4.2 MANAGEMENT SUPPORT

Management support is also hypothesized to influence utilization. In organizations where management is committed to adopting personal computer technology, it seems reasonable to propose that utilization would be high.

The literature supports this contention. In the studies referred to earlier, Lucas (1978) found a positive relation between management support and implementation success (recall he argued that in optional use environments utilization can be used as a proxy for success). One of the studies involved the use of planning models by 25 managers and 16 staff analysts in 21 firms. Simple correlations between management support and five out of seven usage variables were statistically significant, and all correlations were positive.

In the study referred to earlier, Amoroso (1986-a) observed a positive relation between management support and the utilization of user developed applications. Management support was measured as the perception (or belief) of the respondent concerning different aspects of support. These tended to be somewhat technical in nature, such as guidance available for the selection of hardware and software.

Jobber and Watts (1986) surveyed 84 users of marketing information systems in 33 companies located in Great Britain The focus of their study was the influence of attitudes and personality factors on utilization. As part of the study, they also measured ten 'organizational factors' and tested for a relationship between these factors and system utilization. System utilization was measured with seven items, including such things as the percentage of computer-generated reports used, the number of hours spent using reports, and the number of requests for information through the computer system. Ten organizational factors were identified, such as the popularity of the systems department and the perceived sophistication of the organization with respect to information systems and technology. These factors were composed of varying numbers of individual items, and were identified empirically through the use of factor analysis.

The results obtained by Jobber and Watts (1986) showed general support for the hypothesis that organizational factors influence the utilization of systems. Although the operationalization of the constructs was quite different than those adopted by Amoroso (1986) or Lucas (1978), the general results were consistent.

The formal statement of the corresponding hypothesis is:

H2: The greater the perceived Management Support for Personal Computer Use, the greater the Utilization of Personal Computers.

As discussed in section 2.3 (attitudes and system utilization), previous researchers have specified a need to identify and measure separate 'attributes' or components of attitudes (Lucas 1978; Swanson 1982). The next three factors to be examined (expectations, correspondence and general beliefs about using personal computers) were identified for this purpose.

In contrast to the first two hypotheses (relating to experience and management support), the empirical support for the next three hypotheses is not as strong. This is not surprising, since this was the first study to separate the atttitude components and measure the strength of the relations involving each. For this reason the reader may wish to view these relations as propositions, although they are stated (and tested) as research hypotheses.

2.4.3 EXPECTATIONS

The first component of attitudes and beliefs identified was the job related expectations of using a personal computer. This was based on the theoretical work of Vroom (1964) and Lawler (1973). Their research into motivation and the concept of Expectancy Theory suggested that the choices individuals make concerning a behavior will be influenced by their expectations that the behavior will lead to certain outcomes.

Building on his study of attitudes and their influence on utilization, Robey (1979) suggested the adoption of expectancy theory (Vroom, 1964; Lawler, 1973) as a basis for future research, and developed a descriptive model incorporating its use. He believed that expectancy theory could provide the basis on which user attitude research might continue more productively.

In her study of the adoption and use of computer-aided design (CAD) systems, C. Beatty (1986) did adopt expectancy theory as a base for predicting usage. Expectancy theory is a theory of motivation, and she observed a strong relation between motivation and performance. A closer examination of the items used by C. Beatty to measure motivation (such as 'using a CAD system will provide more control over my job') reveals that they could also be viewed as beliefs the individual holds concerning the influence of using a CAD system on certain aspects of their job. In addition, performance was measured both as utilization and by the individual's assessment of the influence of using CAD on his or her job performance.

These findings can be useful for the current study. More specifically, it was stated previously that Lucas (1978) and Swanson (1982) identified a need to differentiate between components of attitudes toward using computers, rather than treating attitudes as a high level construct. Also, Burnkrant and Page (1982) as well as Robey (1979) suggested that in measuring attitudes it is more important to focus on the object of the attitudes than in distinguishing between the cognitive or affective components. Relating this to the study conducted by C. Beatty (1986), the motivation construct she measured could be viewed as the expectations (beliefs) held by the individual concerning the influence of using CAD (in this case, personal computers) on his or her job. Also, since utilization was a component of the performance she measured, C. Beatty's (1986) results support the hypothesis that:

H3: The higher the Job-Related Expectations (beliefs) of Personal Computer Use, the greater the Utilization of Personal Computers.

2.4.4 CORRESPONDENCE

The second component of beliefs was suggested by the conceptual model developed by Goodhue (1986). The interesting contribution of this model (see Figure 2 on page 38) for this research was the development of the correspondence construct. It can be viewed as the beliefs about the degree of correspondence between the job and the computer environment available. In other words, correspondence can be viewed as a second component of attitudes, separate from the expectations defined previously. Although the two may be related, they are not necessarily so. For example, a manager might believe that there is no correspondence between his or her job and the use of a personal computer, but could still hold positive expectations (such as increased status) for personal computer use.

As conceived by Goodhue (1986), the correspondence construct encompasses consideration of the job task characteristics, characteristics of the individual, and characteristics of the information system environment. This implies that measuring the perception of correspondence (or 'attitudinal assessment of correspondence' from Goodhue's model) is sufficient to capture the influence of characteristics of the task, the individual, and the IS environment (at a relatively high level).

The correspondence construct is similar to the one Floyd (1986) termed 'system/work fit' in his research involving the use of a mainframe-based information system by 110 managers and professionals. System/work fit

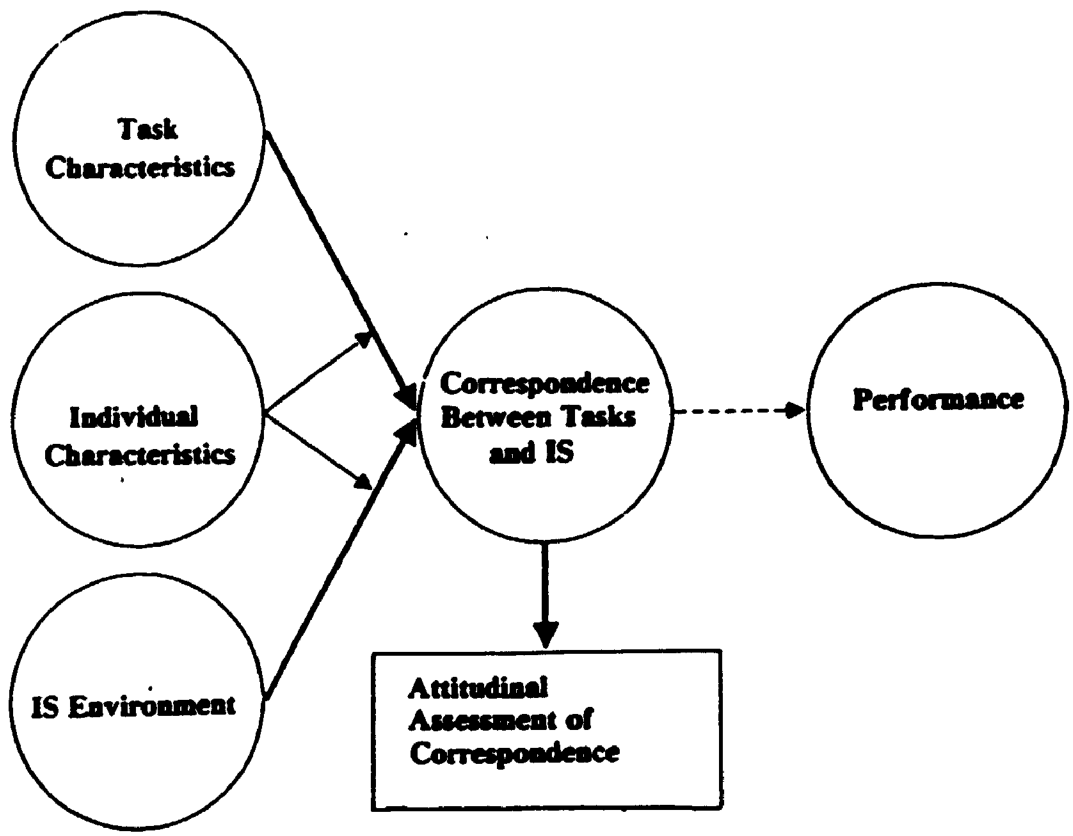


Figure 2. IS Attitudes and Performance: Goodhue, 1986

was operationalized in three ways: 1) facilitating the accomplishment of core tasks, 2) improving the productivity of the individual on the job, and 3) improving the quality of work outputs produced by the subject. Each of these was measured through the attitudes of the individual users. Use of the system was measured (using an electronic monitor) as the time users spent working with the system. Further, Floyd (1986) did observe a positive relation between system/work fit and system utilization, providing support for that portion of Goodhue's (1986) model.

Applying these results to the personal computer environment, the hypothesis derived is:

H4: The greater the Correspondence Between Job Tasks and Personal Computer Use, the greater the Utilization of Personal Computers.

2.4.5 BELIEFS ABOUT PERSONAL COMPUTER USAGE

The third component of beliefs relates to the understanding the individual has concerning the day-to-day use of a personal computer system. The rationale for including this component was expressed (in a more general context) by Lucas (1978):

> "Attitudes and perceptions should also be favorable to encourage high levels of model use. Probably a certain level of positive attitudes is needed for first use of a model; subsequent experience with the model influences attitudes. If this experience is positive, attitudes will become more favorable, creating a positive cycle between use and attitudes."

Lucas (1978) was referring to the use of management science models. It is possible, however, that his observations could also be applied to the optional use of personal computer systems. If individuals hold negative beliefs about the difficulty of use or the time required for using personal computers, or if their initial experiences are negative, they will be less inclined to use personal computers.

Rivard and Huff (1988) surveyed 272 users who had developed applications in 10 different organizations. They developed and tested a model involving factors hypothesized to influence overall user satisfaction. One of the factors was the perception of user friendliness of the software tools employed, and a statistically significant relation was observed between perceived software friendliness and overall user satisfaction.

The context for the study conducted by Rivard and Huff (1988) was not directly comparable (the development of applications using mainframe-based tools vs. the use of personal computers), and the dependent variable (user satisfaction) was not the same. Nevertheless, some researchers have hypothesized or found a relation between user satisfaction and utilization. Also, the friendliness of the software used is one component of the beliefs about using personal computers, as defined here. The relationship observed by Rivard and Huff (1988) may therefore provide some support for the proposed relation between general beliefs about personal computer use and utilization.

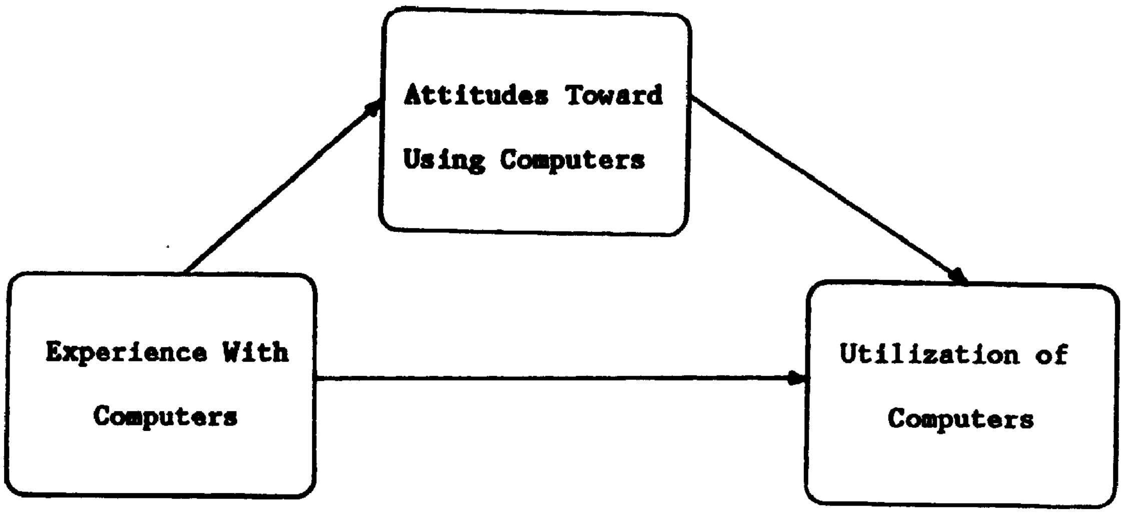
Howard (1985) developed a scale designed to measure the attitudes of managers toward personal computers. The final version of the measurement scale contained items such as 'working with personal computers is so complicated, it is difficult to understand what is going on' and 'using a personal computer makes work more interesting'. These items measure beliefs about the day-to-day use of a personal computer, and Howard's (1985) objective was to develop a measure of user attitudes toward personal computers which could subsequently be used in research investigating the relation between attitudes and use. Within the context of this research, the measurement scale developed by Howard relates to beliefs about personal computer use, and not the other attitude components. The argument is that beliefs about using a personal computer can be measured separately from beliefs about correspondence or expectations about use, and that beliefs about using personal computers will influence utilization.

It is not immediately obvious to what extent this component of attitudes and beliefs has been employed in previous research involving attitudes and the use of information systems. There does not appear to be any previous study where this component of beliefs was measured separately, or where its influence on utilization was considered. The rationale provided, however, coupled with the limited support found by Rivard and Huff (1988), suggests that:

H5: The more positive the Beliefs About Personal Computer Usage, the greater the Utilization of Personal Computers.

2.5 Factors Affecting Utilization Indirectly

The previous five hypotheses dealt with factors believed to have a direct influence on the utilization of personal computers. These included experience, management support, expectations, correspondence, and usage beliefs. In addition to the direct relations discussed above, a number of indirect relations can also be proposed. For example, experience with computers has been found to influence attitudes toward using computers, which in turn influence the utilization of computers (Lucas, 1978). This is in addition to the direct influence that experience exerts on utilization. Diagrammatically, this could be illustrated as:



Similarily, a relation has been observed between management support and attitudes (Lucas, 1978; Bruwer, 1984; Jobber and Watts, 1986). Since the three attitude components have been shown/hypothesized to influence utilization (discussed in sections 2.4.3, 2.4.4 and 2.4.5), indirect relations may also be proposed between exerience and utilization, and management support and utilization, through each of the attitude components. This was the first time these three attitude components have been separated and measured, however, and subsequently each of the potential relations needed to be examined. To be more specific, the construct 'attitudes toward using personal computers' is being replaced with expectations, correspondence and usage beliefs. Support has been found for a positive relation between experience and attitudes toward using computers, but this does not automatically provide support for relations between experience and each of expectations, correspondence and usage beliefs.

Once more the reader may wish to view the hypothesized relations as propositions, since direct empirical support is not available. In a sense, support for these relations has been included in previous studies where attitudes were defined and measured at a higher level.

2.5.1 EXPERIENCE

One potential hypothesis is between personal computer experience and the job related expectations of using personal computers. The rationale for this relation is that as individuals gain experience with using personal computers, their expectations concerning the influence on related aspects of their job (such as the amount of variety on the job) will increase. This was supported by the work of C. Beatty (1986) who observed a positive relation between skills and abilities (one component of experience) and motivation (once more, this was measured similarily to the expectations construct here). The context is not the same (the use of CAD systems versus the use of personal computers). It is argued, however, that there is sufficient commonality to provide support for the hypothesis that:

H6: The greater the level of Personal Computer Experience, the greater the Job-Related Expectations of Using Personal Computers.

A second indirect hypothesis is the relation between experience and the perceived correspondence between job tasks and personal computer use. The motivation for this relationship is that as individuals gain experience with personal computers they can see greater opportunities for using them. For example, novice users of Lotus 1-2-3 (a spreadsheet package) would not see as many potential applications for their job as experienced users who understand the capabilities of the software.

Limited support for this hypothesis is provided by the work of Goodhue (1986). He proposed that individual characteristics (including experience) will affect the perception of the correspondence between job tasks and the IS environment. The corresponding hypothesis is that:

<u>H7:</u> The greater the level of Personal Computer Experience, the greater the perceived Correspondence Between Job Tasks and Personal Computer Use.

A third indirect path into utilization is the relation between experience and beliefs about the use of personal computers. It has been argued in the past that experience can be one of the strongest influences on attitudes, and this hypothesis has been supported in numerous previous studies (including those reported by Triandis, 1980). McLean (1979) suggested that:

> "What is very logical and obvious to a DP professional can be very confusing and mysterious to the manager attempting to find out a critical item of information locked away somewhere in the system."

As managers gain experience with the system, however, it becomes less confusing and frustrating to use.

In their investigation of the satisfaction of user developers with user developed applications, Rivard and Huff (1988) found a strong, positive relation between computer background and the perception of user friendliness of software tools. Specifically, Rivard and Huff (1988) found that a given software tool could be viewed as quite friendly and easy to use by some users, but be viewed as very unfriendly by others. They suggested that differences in computer background could account for the differences in perception, and found support for this in their study.

These findings can be related to the use of personal computers by managers. If a manager has no experience with personal computers, he or she may perceive any use of a personal computer negatively (difficult to use, not interesting, and so on). On the other hand, a manager with prior experience will have a better basis for the formation of attitudes toward using a personal computer, and may hold more positives attitudes. The corresponding hypothesis is:

H8: The greater the level of Personal Computer Experience, the more positive the Beliefs About Personal Computers Usage.

2.5.2 MANAGEMENT SUPPORT

In the series of studies referred to previously, Lucas (1978) found a direct path from management support to utilization. He also observed an indirect relation between management support and utilization, through attitudes and perceptions (beliefs). His study, however, did not differentiate between separate components of attitudes. Similar to the approach discussed with experience (in section 2.5.1), it was necessary to examine each of the possible indirect relations (management support to expectations, management support to correspondence and management support to general beliefs about using personal computers), and decide whether they could be supported.

Without evidence to the contrary, it would appear that management support could influence the related expectations of using personal computers. If there is a perception of strong support for the use of personal computers by senior managers, then this would influence expectations about the use of personal computers (such as increased status).

Similarily, if the perception exists of ready access to assistance for hardware and software difficulties, then this would tend to decrease concerns about the difficulty of actually using personal computers.

The potential relationship between management support and correspondence is not as clear. As with the previous two relations, it depends very much on the actual operationalization of the constructs. For example, if management support is defined as containing specific training in the applicability of software products for individual job tasks, then an argument could be made for this relation. In this case, however, this component of support was not included and hence there can be little justification for the existence of the relation within the context of this research. (The specific items chosen for operationalizing the constructs are discussed in the following chapter).

For these reasons, the following two hypotheses were generated:

H9: The greater the perceived Management Support for Personal Computing, the more positive the Job-Related Expectations of Personal Computer Use.

H10: The greater the perceived Management Support for Personal Computing, the more positive the Beliefs About Personal Computer Usage.

2.6 Utilization and Performance

The previous sections focused on factors hypothesized to influence the utilization of personal computers by knowledge workers. In a sense, utilization was viewed as a dependent variable. Utilization can also be viewed as an independent variable with an influence on job performance.

Researchers investigating the use of information systems are generally interested in the relation between utilization and performance, but have difficulty in measuring performance (Sink, Tuttle and DeVries, 1984). Several alternate approaches have been advocated and employed.

A number of researchers have argued for the use of user satisfaction as a surrogate measure for 'implementation success' or 'information system effectiveness', and measures of user satisfaction have been developed (Bailey and Pearson, 1983; Ives, Olson and Baroudi, 1983). For example, Rivard and Huff (1988) conducted a study investigating factors which influence the overall satisfaction of end users with EUC. User satisfaction was employed as the major dependent variable. The major assumption underlying the adoption of user satisfaction as a surrogate is that a strong, positive correlation exists between user satisfaction and performance. The existence of such a relation has not been demonstrated for the use of personal computers by knowledge workers, and hence this approach was not adopted.

Other approaches to measuring system effectiveness have been proposed, and one which has received considerable attention is utilization of the system (Ein-Dor and Segev, 1978; Lucas, 1978). Ginzberg (1981) argued against the system usage approach, stating that the link between system usage and the quality of decision making was a weak one. Srinivasan (1985) examined modeling systems in 29 organizations to test the relationship between system usage and user satisfaction. He observed no strong, positive relation, and suggested this was not surprising since modeling systems can be used sporadically and still be effective. Srinivasan (1985) concluded that it might be a good idea to assess the role of behavioral measures separately from perceived measures of system effectiveness.

The perspective explored by Srinivasan (1985) was that behavioral indicators (utilization) and perceptual indicators (user satisfaction) can be viewed as two distinct ways of measuring the same higher-order construct, system effectiveness. Trice and Treacy (1986), however, suggest that utilization can be viewed as an intervening variable between availability of IS technology and performance. From this perspective 'system effectiveness' could be viewed as a moderating variable; that is, a factor which moderates the relation between utilization and performance.

As mentioned earlier, measuring the performance of knowledge workers (and hence the influence of utilization on performance), is no simple task (Sink, Tuttle and DeVries, 1984). Trice and Treacy (1986) suggest that an alternate approach is to measure related aspects of job performance such as the effectiveness of analysis for decision making. This approach was adopted here. It should be noted, however, that the primary purpose of the research is to understand the factors affecting utilization. The relation to performance is included for completeness. The related hypothesis is:

<u>H11:</u> The greater the Utilization of Personal Computers, the greater the perceived Job-Related Aspects of Performance.

2.7 Conceptual Model

The conceptual model (see Figure 3 on page 50) was generated by combining the hypotheses developed throughout this chapter. Each relation shown on the model corresponds to a single hypothesis.

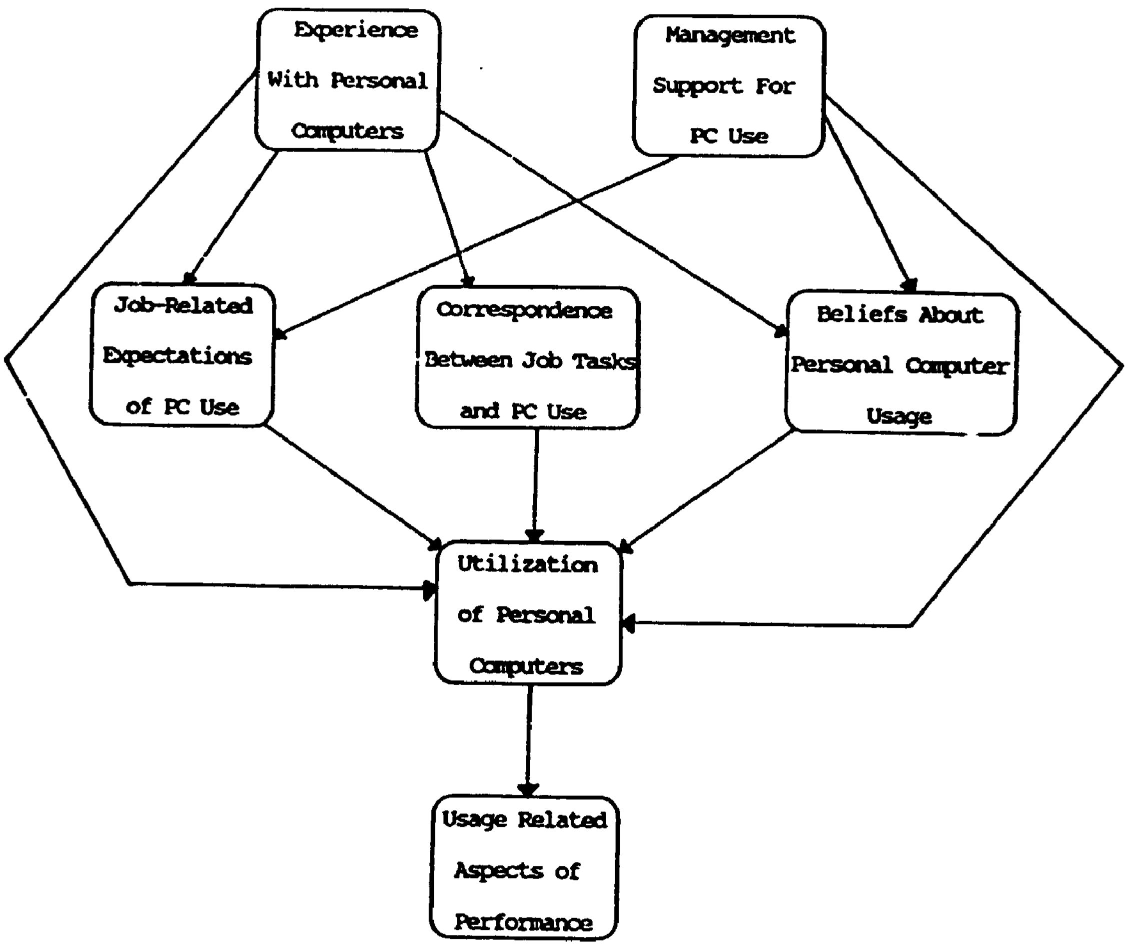


Figure 3. Conceptual Model of Utilization

The model predicts that five factors will influence the utilization of personal computers directly. These are experience with personal computers, management support for personal computer use, job-related expectations of personal computer use, correspondence between job tasks and personal computer use, and beliefs about using personal computers. In addition, the model suggests that experience will influence each of expectations, correspondence and usage beliefs. Similarily, management support is proposed to influence expectations and usage beliefs. Utilization of personal computers is also hypothesized to influence job-related aspects of performance.

The primary purpose of the model was to isolate the role of attitudes and beliefs with respect to the utilization of personal computers. By separating the three components of attitudes in a causal model, the relative strength of the attitude components can be assessed. Experience and management support were included both to examine their influence on each of the attitude components, and to compare the relative strength of the relations involving experience and management support with those involving the attitude components.

The choice of a causal model (rather than an alternative such as a multiple regression model involving only direct relations) needs to be clarified. The relations illustrated in the model are directional, implying causality. Also, the hypotheses were stated in a causal context. In the context of the current study, however, the separation of a higher-order construct (attitudes) into component parts led to the identification of relations which have not not been tested empirically. The theoretical base for these hypothesized relations is therefore untested. Thinking causally about the problem and constucting a model that reflects causal processes facilitated a clearer statement of the potential relations, but empirical support should not necessarily be interpretated as supporting the hypothesized direction of these relations. The interpretation of the nature of the relationship is dependent upon both a priori theoretical knowledge and on empirical findings (Fornell, 1984).

2.8 Additional Factors Influencing Utilization

In addition to the variables already discussed, other factors have been hypothesized to influence the utilization of information systems. Three of these are individual differences (Zmud, 1979), system quality (Lucas, 1978), and group norms (Pavri, 1988). Each of these will be examined briefly, and the reasons for excluding them from the conceptual model discussed.

One line of inquiry has examined the role that differences between individuals plays in the utilization of systems. Zmud (1979) reviewed a number of studies which included various aspects of individual differences. He groupted them into three major categories; cognitive style, personality, and demographic/situational variables. Huber (1983) reviewed literature related to the influence of cognitive style, and concluded that the evidence suggested that any influence on utilization was too small to be of consequence, and questioned the advisability of pursuing that line of inquiry. In his comment on Huber's (1983) paper, Robey (1983) agreed with many of Huber's comments, but argued that individual differences could still be an important consideration during the development process.

Zmud (1979) also found no clear evidence of an influence by either cognitive style or personality. It appeared that there might be some support for a limited number of differences, but even for these the effects were not large.

Fuerst and Cheney (1982) conducted a study of DSS utilization in the oil industry. They surveyed 64 respondents using 8 differenct decision support systems. One of the factors they examined was characteristics of the individual respondents, relating to the demographic/situational factors identified by Zmud (1979). They found no relation between factors such as age and education and receptivity towards using a system.

The implications for this research are that individual differences (such as cognitive styles) may have a direct influence on personal computer utilization, as well as an indirect influence through attitudes. Previous studies have not been able to identify the most important differences, however, and there is little indication that the magnitude of the influence would be large. Also, the correspondence construct as defined by Goodhue (1986) does allow for the influence of individual differences.

His model shows individual 'characteristics' moderating the relations between job characteristics and correspondence, as well as between the IS environment and correspondence. In this way any individual differences will influence the perception of correspondence. Since the influence of individual differences is not clear (Huber, 1983) and the correspondence construct includes some consideration of individual characteristics, individual differences were not included as a separate construct in the conceptual model.

Lucas (1978) found a positive relation between the quality of the system and attitudes and perceptions, and also between the quality of the system and utilization. It is argued that the influence of system quality is captured by the correspondence construct as well, since the perception of correspondence is influenced by the perception of the IS environment (including quality). The systems used by the respondents in this research were all IBM-compatible personal computers, and most repondents had access to commonly used software packages. The quality of the systems were therefore comparable. For this reason system quality was not included as a separate construct.

Pavri (1988) used the Theory of Reasoned Action as the basis for his investigation of the relation between attitudes toward using personal computers and the use of personal computers. Responses were collected from 519 individuals in 54 companies. LISREL was used as the technique for data analysis. A relatively strong relation was observed between attitudes and use (beta coefficient of .43), with a much weaker relation between group norms and use (beta coefficient of .16). These results provided support for a positive relation between group norms and utilization, but suggested that the influence of group norms was too small to be included in this research. Once more, only factors with a major influence were of interest, and the focus was on the role of individual attitudes and beliefs.

This chapter has reviewed relevant literature to describe the topic of interest, and also to develop a conceptual model of personal computer utilization. The following chapter describes the general approach taken in the research study, including specific consideration of the data collection and data analysis techniques.

CHAPTER 3 - RESEARCH METHODS

3.1 Introduction

This chapter describes the approach taken for this research study. It begins with a discussion of general issues which need to be addressed for any research. This is followed by a description of the chosen research design, and justification for its selection. Next, the data collection technique is discussed in some detail. Since the method adopted was somewhat novel, it was believed that more detail should be provided than might otherwise be warranted. The technique for data analysis (Parial Least Squares - PLS) is described extensively as well, as it is also relatively new. A description is provided of the general objectives and capabilities PLS. The implications of using PLS in the testing of measurment scales are discussed, and the chapter concludes with a description of using PLS to test hypotheses and the predictive power of causal models.

Cook and Campbell (1979) suggested that researchers need to consider four types of validity for any research study - statistical conclusion, internal, construct and external validity. Sawyer and Ball (1981) contend that these validities correspond to four key research questions:

1. Is a relationship present?
2. If so, can the causal relationship be attributed properly to the cited independent variable and not any other?
3. What particular cause and effect constructs are involved in the relationship?

4. To what people, settings, and times can the relationship be generalized?

Each of these questions has potential implications for the way in which a specific research study is designed and/or the method of data analysis adopted. The usual approach for addressing the first question (the presence or absence of a relationship) is through statistical tests of significance. Related issues include the reliability and validity of the measures employed, and the replicability of the results.

One method of addressing the second question is by holding other factors which could influence the relationship constant. For example, collecting data from respondents from a single organization reduces the possibility that organizational factors will influence the relationship being examined. Another approach is the random selection of respondents from the population of interest. Once again the potential influence of extraneous factors is reduced.

The third question can be addressed by examining the way in which the theory (hypothesis) was developed (Zaltman, LeMasters and Heffring, 1982). More specifically, a research hypothesis involves at least two constructs and one relationship. Questions can be raised concerning the strength of the theory which led to the hypothesis, whether any competing theories were considered, and so on.

The fourth question deals with the issue of generalizability, which basically asks whether the results obtained from the sampled observations are representative of the population of interest. The random sampling of respondents from the population is one method, providing that each potential respondent has an equal chance of selection. When true random selection is not feasible, it is still possible to ensure the respondents are representative on those factors considered most important. Replicating the study with a different sample can also enhance the generalizability of the results, providing the subsequent samples differ from the first on potentially important factors. In the case of a study focusing on business managers, this could mean sampling across industry sectors.

This chapter discusses the choice of research design, with reference to the issues raised above. The data collection technique is presented, and the data analysis methodology chosen for the research is examined. Consideration is given to testing the measures employed as well as the research hypotheses.

3.2 Research Design

Before determining an appropriate research design or data analysis methodology, it is necessary to identify the focus and objectives of the research. The phenomenon of interest for this research was the use of personal computers by knowledge workers and managers. Both stand-alone systems and those connected through telecommunications facilities to other systems were examined.

The population of interest was individuals who used personal computers to assist them with job-related tasks. Further restrictions were that use must be optional, and the individual had ready access to a personal computer system. The term knowledge worker was defined to include professionals and managers, but was meant to exclude clerical staff. The unit of analysis was the individual.

The primary objective of the research was to develop and test a conceptual model relating components of attitudes and behaviors with the utilization of personal computers. The objectives of the research design and choice of data analysis methodology were to provide the most efficient and effective tests of the hypothesized relations, given certain practical constraints (cost and time, for example).

The population of interest for the research was knowledge workers (professionals and managers) who use personal computers on their job. One immediate constraint for the research was the choice of respondents. Ideally a sampling frame could have been generated, listing all potential respondents from the population of interest. From this sampling frame a sample of respondents could be chosen at random, providing the benefits of random selection.

Unfortunately, there was no practical method of developing an appropriate sampling frame. Personal computers are used by employees of large organizations as well as by the sole proprietors of small businesses. Identifying all potential respondents would be a monumental task, and the population of interest constantly changes. For this reason it was decided to select respondents who were believed to be representative of the population. Individuals were chosen from small a⌣ well as large enterprises, from public and private organizations, and from across industry sectors.

Internal validity also has implications for the research design. Specifically, the internal validity of a research study may be enhanced by using a laboratory experiment. This allows for relatively strong control of extraneous factors, but may also decrease the generalizability of the results. It was believed that examining the attitudes of knowledge workers toward using personal computers in a laboratory environment could raise serious questions about the external validity of any results, and hence it decided to employ a survey approach in a field setting.

The issue of determining whether or not a proposed relation exists is very important, and the use of statistical tests of significance can be helpful in this regard. Sawyer and Peter (1983) suggest, however, that statistical significance testing does not provide evidence about the replicability of results. As Stevens (1971) stated:

> "In the long run, scientists tend to believe only those results that they can reproduce. There appears to be no better option than to await the outcome of replications. It is probably fair to say that statistical tests of significance, as they are so often miscalled, have never convinced a scientist of anything."

To address the issues of replicability and generalizability of the results, as well as the reliability and validity of the measures, the research design involved a two-phased approach. The first phase (pilot study) employed a single organization with a large number of potential respondents. The primary objectives of the pilot study were to test the measures developed for the various constructs, and to test the structural model (relations among the constructs). Since all of the data for the pilot study were obtained from a single organization, the internal validity of the results was enhanced (Kerlinger, 1973). That is, some variables which could potentially influence the results were held constant (such as organizational climate).

The second phase of the research (primary study) focused on replicating the research and obtaining more generalizable results. Data were obtained from ten divisions of eight diverse enterprises. Both public and private organizations were involved (see Appendix I for a list of participating enterprises). It was believed that more confidence could be placed in those results from the first phase that were replicated in the second.

An issue related to the generalizability of the results is the potential for non-response bias. That is, there always exists the possibility that those individuals who chose not to respond to the questionnaire would have answered differently than those who did. This, in turn, would imply that the sample of responses was not representative. To address this issue, an effort was made to obtain as high a response rate as possible. The reasonably high response rates obtained (62% and 80% for phase 1 and 2, respectively) coupled with the analysis of non-respondents (discussed in chapter 4), gave no indication of a threat from non-response bias.

Another issue relating to the replicability of the results and validity of the findings is the reliability and validity of the measures chosen and/or developed. Peter (1979) suggests that, in a general sense, validity refers to the degree to which instruments truly measure the constructs which they are intended to measure. Reliability can be broadly defined as the degree to which measures are free from error, and therefore yield consistent results (Peter, 1981).

The reliability and validity of the measures used in the research were considered during the development of the research instrument, by adopting previously tested measurement scales wherever possible. After the data was collected for the first phase of the study, the measures were tested for reliability and validity and revised slightly. Once the data were collected for the second phase, the measures were tested again.

3.3 Data Collection Technique

The data collection methodology used was a modification of the Total Design Method (TDM) developed by Dillman (1978). TDM is a total methodology for survey research, developed with the primary objective of increasing response rates for large-sample research. The approach evolved over a period of years, with substantial modification and testing by Dillman and his colleagues. For mail surveys to the general public involving lengthy questionnaires, studies using the TDM approach have achieved response rates from 60 to 75 percent.

Dillman (1978) suggested several ways to increase overall response rates. One was to ensure that the questionnaire did not exceed 12 pages in length. It was also recommended that the questionnaire be presented as a booklet, consisting of sheets of paper 8 1/4 inches by 12 1/4 inches folded in half and stapled. No questions are placed on the cover pages, and the material for the pages is photo-reduced to 79% of the original size. The questionnaire booklets are reproduced with a quality printing method on white or off-white paper. Other recommendations relate to the format and sequencing of questions, the content and format of covering letters and follow-up letters, and the timing of the various mailings. The TDM for mail surveys relies heavily on personalization throughout the implementation process.

For this research, Dillman's recommended format for correspondence was used, and suggestions for the content and timing of correspondence were followed. Certain modifications were necessary, primarily since Dillman (1978) was addressing the use of questionnaires printed on paper, while the ones employed in the study were programmed on computer diskettes.

The data were collected in the following manner. A list of prospective respondents (and the division they worked for) was obtained from each organization. Unique numbers were used to identify questionnaires, not names, and the list of names with corresponding identification numbers was held by the researcher. The questionnaires were distributed to the respondents through each company's internal mail system, accompanied by a covering letter from the researcher and one from an appropriate executive from the organization (see Appendices II and III for sample covering letters). In the pilot study, completed questionnaires were returned to a representative for the organization. The researcher then obtained them from the organizational representative. For the second phase, the completed questionnaires were returned directly (in self-addressed, stamped envelopes) to the researcher. In both phases a follow-up letter was sent to non-respondents (see Appendix IV for a sample follow-up letter).

The major distinguishing feature of the data collection was that the questionnaires were copied onto computer diskettes, and the respondents completed them interactively through the use of personal computers. The diskettes were enclosed in protective mailers before being distributed to the respondents.

This method was chosen for a number of reasons. First, the use of an interactive medium has the potential to stimulate and hold the respondent's interest. It was believed this could result in a higher response rate. Second, since the responses were recorded electronically, it was possible to avoid the time-consuming and costly process of transfering data from written questionnaires to a computerized database for further analysis. In addition, the potential for errors occurring in the process of transcribing responses was eliminated (that is, coding errors).

Computers are playing an increasing role in data collection, and specifically in survey-based research. For example, in computer-assisted telephone interviewing (CATI), interviewers telephone subjects, read questions from video screens, and record responses directly into a computer. Since the introduction of personal and portable computers, researchers have developed several forms of computer-assisted personal interviewing (CAPI). Interviewers have taken personal computers into the homes and offices of respondents (Mount, 1980; Dijkstra and van der Zouwen, 1982; Freeman and Shanks, 1983). They have also used personal computers or terminals to collect data at trade shows, professional conferences and other events where potential respondents gather (Whalen, 1984). Sproull (1986) suggested that electronic mail could be used to collect data in organizational research.

The ability to program a questionnaire allows the inclusion of features that would be too unwieldy or complex with a paper questionnaire. The diskette-based questionnaires (termed DISKQ by Higgins, Greenwood and Dimnik, 1987) can perform complex and invisible branching. The respondent does not need to know that a response has initiated branching, since the program automatically skips to the appropriate section. In addition, different transitions can be used, such as scrolling through a specific section and then breaking (with a clear screen) between sections. This can be combined with the use of colors and highlights to keep the interest of the respondent high. In a study conducted by Higgins, Greenwood and Dimnik (1987), response rates for DISKQ were slightly higher than for the equivelent paper questionnaires, but not significantly so (66% for DISKQ and 63% for paper questionnaires).

The use of DISKQ also has a number of potential drawbacks. Most importantly, the potential respondents must have ready access to a compatible personal computer system. Also, they must have the technical knowledge necessary to complete the questionnaire. Finally, it is possible that the method of data collection (use of a personal computer) may introduce some bias in the results. For example, some individuals may choose not to respond because they are intimidated by the technology (selective response bias).

These potential risks and benefits were evaluated before choosing the DISKQ approach. The benefits were considered to be substantial; larger samples could be obtained, at a lower relative cost and with the potential for a higher response rate (Greenwood, Higgins and Dimnik, 1987). The risks, although potentially high for some types of research, were estimated to be low for this study. Specifically, the population of interest was knowledge workers who had ready access to a personal computer and who used a personal computer to some extent. Also, the DISKQ questionnaire was programmed in such a way that it required minimal instruction and was very easy to use. A previous study using both paper and diskette-based questionnaires found no evidence of selective response bias (Higgins, Dimnik and Greenwood, 1987). In addition, all potential respondents for this study were familiar with personal computer usage, which, coupled with the relatively high response rates, indicated little potential for selective response bias.

3.4 Data Analysis Technique - Partial Least Squares

The data analysis technique chosen for this research was Partial Least Squares (PLS). PLS is a regression-based technique, with its roots in path analysis (Pedhazur, 1982; Wold, 1985). It has emerged as one approach to multivariate analysis in what Fornell (1982) terms a shift from the first generation to the second generation.

This relatively new approach to the analysis of structural equation models is designed to handle models involving multiple latent variables (constructs), each of which is measured by multiple manifest (observable) variables (indicators). In addition, the method allows simultaneous modeling of the relations among the latent variables (inner relations) as well as the relations between each indicator and its latent variable (outer relations). For example, one could look at the effect of experience (a construct) on utilization (another construct). Each of these constructs could be defined by multiple measures such as length of use and skill level (for experience) and frequency and duration of use (for utilization). Since constructs get their meaning from their measures and the theoretical context in which they are used, the simultaneous analysis embodied in structural equation modeling is far superior to traditional techniques (Fornell, 1984).

Causal modeling or structural equation modeling accommodates a priori knowledge derived from theory, previous empirical findings, and/or research design, and, as Fornell (1982) states:

> "...because these methods can combine as well as confront theory with empirical data, they offer a potential for scientific explanation that goes far beyond description and empirical association."

The additional capability of structural equation models to treat measurement error both in the relationships between latent and manifest variables (constructs and indicators), and in the observations at the empirical level, makes this approach most suited to social science data which are seldom error free (Barclay, 1986).

The most widely known implementation of structural equation modeling is the LISREL computer program developed by Joreskog and Sorbom (1981). This approach has been used fairly extensively, even in some cases where the underlying assumptions and estimation objectives have not been appropriate for the chosen research problem.

LISREL is most suited to research problems where there exists strong theory; where indicators or observed variables are reflective of constructs as opposed to forming constructs or indices; where data are multivariate normal and intervally scaled; and where sample sizes are rel--ively large. Also, the emphasis of LISREL is on model fit. Specifically, LISREL's aim is to estimate model parameters such that the discrepancies between the empirical covariance matrix and the covariance matrix deduced from the model structure and the parameter estimates, are minimized.

PLS, developed by Wold (1985), is a less well known implementation of structural equation modeling. PLS comes into play in many cases where the application of LISREL is inappropriate. The choice of PLS over LISREL seems to make sense in earlier stages of theory development, whereas LISREL applies to later stages (Fornell, 1984). PLS is more applicable in research areas where theoretical knowledge is not as strong as demanded by LISREL, and where data do not meet the requirements of LISREL's maximum likelihood estimation (MLE) (1). Lohmoller (1982) suggests that PLS methods are closer to the data, more explorative, and more data analytic.

In contrast to LISREL, PLS has as its objective the explanation of variance via ordinary least squares (OLS), that is, the minimization of

---

(1) It should be noted that some findings (Boomsa, 1982; Dijkstra, 1983) suggest that under certain circumstances the maximum likelihood methods of LISREL can be considered robust, reducing the importance of this concern.

residual variance in the model. This contrasts with LISREL's aim of minimizing residual covariance, and makes PLS more predictive in a traditional regression sense (Barclay, 1986).

Another advantage of PLS is that it allows the researcher to use both formative and reflective indicators in the measurement model. Fornell (1984) classifies formative indicators as those used when researchers do not have a clearly defined and readily measurable construct, and hence the indicators form the construct within the context of the study. The indicators are assumed to be a collection of variables, informative about a matter of unknown dimensionality and unknown representativeness (Lohmoller, 1981). An example is experience with personal computers, which is not well defined and may contain multiple dimensions (such as length of use, experience with other types of computer systems, number and type of packages familiar with, and so on). This contrasts with relatively well-defined constructs (such as management support) which the researcher believes will be reflected by the indicator scores.

Another important contrast is that PLS can be applied to relatively small samples of data. This is because the iterative algorithm behind PLS estimates parameters in only small subsets of a model during any given iteration. Subsequent iterations address other overlapping subsets and the process is repeated until selected convergence criteria are met (Fornell, 1984). The subset estimation process consists of nothing more complex than simple and multiple regressions, so the sample required is that which would support the most complex multiple regression encountered. Thus sample size requirements, using the general rule of thumb of ten cases per indicator, becomes ten times the number of indicators for the most complex construct (Fornell, 1982; Barclay, 1986).

The hypotheses developed in the second chapter were formulated and presented as testable hypothese, not as propositions. As was mentioned previously, however, the separation of the attitude constreuct into component parts resulted in the development of relations which were prevously untested. This is also related to the use of formative indicators (discussed later), where constructs are not well defined and adequate measures have not been developed and tested.

Given (i) the need for formative indicators, (ii) the stage in theory development of personal computer related research, and (iii) the uncertain distribution of the data, PLS was chosen as the appropriate data anlysis technique for this study.

The computer program used for analysis in this study was LVPLS (Latent Variable path analysis with Partial Least Squares estimation), implemented by Lohmoller (1981). One of the major limitations of Lohmoller's LVPLS program is that it is intended only for recursive(1) models. This restricts the use of the program to models involving unidirectional relations, in effect removing the possibility of feedback loops. If a non-recursive model is used, the estimation of the latent variables will be correct, but the path matrix (path coefficients) may be incorrect (Lohmoller, 1981).

The PLS iterative estimation process generates estimates for a number of parameters, for two sets of equations. The structural equations represent the direct and indirect non observational relationships or paths among the constructs (latent variables); the measurement equations represent the epistemic relationships between the observed (manifest) variables and the constructs which they measure. Regarding the statistical properties of these parameter estimates, they are biased and not consistent, but are consistent at large. As the number of indicators (or measures) of constructs increases and as the number of cases increases, PLS estimates approach the true values (Lohmoller, 1982). The efficiency of PLS estimates is unknown.

The issue next becomes assessing the measurement model and the structural model for reliability, validity, hypothesis support, and statistical significance. These are described in the following sections.

---

(1) The definition of recursive and non-recursive models used here is adopted from Lohmoller (1981).

3.5 Test of Measures

The first step in a PLS analysis is to examine the construct validity of the measurement scales, within the context of the overall model. Researchers employing first generation techniques often calculate Cronbach's alpha coefficients (Cronbach, 1951) and use factor analysis to test the reliability and validity of measurement scales. By doing this they restrict themselves to testing the measurement model (relations between each indicator and its construct) apart from the structural model (relations among the latent variables). PLS allows the researcher to test the measures for each construct within the context of the entire model, by examining the loadings of each indicator with its associated construct.

Two important dimensions of construct validity are 1) convergent validity, including reliability, and 2) discriminant validity. These can be assessed in turn with the classical true-score model of measurement (Lord and Novick, 1968) as the underlying premise.

3.5.1 CONVERGENT VALIDITY AND RELIABILITY

Convergence refers to the degree to which two or more attempts to measure the same construct by different methods are in agreement (Campbell and Fiske, 1959). Reliability and convergent validity were assessed by examining: the reliability of each measure; the composite reliability of each scale, i.e. its internal consistency; and the average variance extracted by each construct. This approach has been adopted by previous researchers (Barclay, 1986; Rivard and Huff, 1988; Pavri 1988).

The reliability of a measure y is:

$$\rho_y = \frac{\lambda_y^2}{\lambda_y^2 + var(\epsilon_y)}$$

where λ_y is the factor loading of y on its associated construct in a single factor model, and ε_y is the error in measurement (Fornell and Larcker, 1981). With standardized variables, the reliability of a measure is simply its squared loading.

With PLS, one examines the loadings of the measures on their corresponding construct. A good rule of thumb is to accept items with loadings greater than .7 (Fornell, 1984). Since loadings are correlations and squared loadings are the variance explained, a loading of .7 translates into 50% of the variance explained. This implies that the measure has more explanatory power than error variance.

When weak loadings (below .7) are observed, it is necessary to determine if the indicator (measure) is not reliable, if it measures a different construct or if the construct is multi-dimensional. Again, the advantage of this technique is that the measurement model is examined within the context of the theoretical model.

The composite reliability of a scale, or its internal consistency is:

$$\rho_{n} = \frac{\left(\sum_{i=1}^{p} \lambda_{y_i}\right)^{2}}{\left(\sum_{i=1}^{p} \lambda_{y_i}\right)^{2} + \sum_{i=1}^{p} var(\varepsilon_i)}$$

where y , i = 1,...,p are the multiple measures of a construct (Werts, Rock, Linn, and Joreskog, 1978). Composite reliability is similar to Cronbach's alpha as a measure of internal consistency except the latter presumes, a priori, that each indicator of a construct contributes equally. That is, the loadings (λy) are set equal to unity. The composite reliability is more general than Cronbach's alpha, but the interpretation of the values obtained is similar. Specifically, the standards suggested by Nunnally (1978) for Cronbach's alpha coefficients (Cronbach, 1951) can be adopted for the composite reliability (Bagozzi, 1982).

Fornell and Larcker (1981) propose that to more fully examine the composite reliability in the measurement scale, the average variance extracted or the average variance shared with a construct be assessed. This is:

$$\rho_{vc\,(n)} = \frac{\sum_{i=1}^{p} \lambda_{y_i}^{2}}{\sum_{i=1}^{p} \lambda_{y_i}^{2} + \sum_{i=1}^{p} var(\varepsilon_i)}$$

which, with standardized variables, reduces to the mean of the squared loadings of the p measures of the construct η . If $\rho_{vc(\eta)}$ is less than .50, the variance due to error in measurement is greater than the variance captured by the construct (η), and the validity of the individual indicators (λ_y), as well as the construct (η), is questionable. The shared variance extracted ($\rho_{vc(\eta)}$) is a more conservative measure than (ρ_η) or Cronbach's alpha.

3.5.2 DISCRIMINANT VALIDITY

Discriminant validity indicates the extent to which a given construct is different from other constructs. Discriminant validity was assessed within the PLS framework as suggested by Fornell, Tellis and Zinkhan (1982).

One criterion for discriminant validity is that the correlations between constructs be significantly different from unity. Lohmoller's (1981) LVPLS program produces a matrix displaying the correlations among the latent variables. These correlations can be examined to ensure none are so highly intercorrelated as to be the same construct.

An additional criterion for discriminant validity is that the variance shared between any two constructs be lower than the variance shared between either of these two constructs and their respective measures. In practical terms, this means that the average variance extracted for each of two constructs (say A and B) should be higher than the path coefficient between A and B. Once more, the LVPLS program provides the necessary information to conduct this test.

One final criterion for discriminant validity is that each indicator should load more strongly on its associated construct than on any other construct. This criterion can be tested within PLS by examining the 'factor structure', which is a listing of the loadings of all indicators on every construct. If a given indicator loads more highly on any construct other than the one it was intended to measure, then this criterion for discriminant validity has been violated.

3.5.3 REVISION OF THE MEASUREMENT MODEL

There are no standard rules for revising the measurement model. Generally there exists a trade-off between the desire for valid and reliable measures on the one hand, and capturing as much of a construct (content validity - Nunnally, 1978) as possible on the other. For exploratory studies, it is generally accepted practice to relax the requirements slightly in an effort to gain as much understanding as possible. With more formal tests of hypotheses, it is necessary to ensure high levels of reliability and validity are achieved (Nunnally, 1978).

The process of revising the model involved examining each of the indicators for each of the constructs in turn. In addition, the composite reliability and average variance extracted were also considered. Where the loading for an indicator was less than 0.7, the indicator was examined to see if there existed any rationale for either retaining it or removing it.

3.6 Test of The Structural Model

Examination of the structural model is the assessment of nomological validity (Peter, 1981) or "the degree to which predictions from a formal theoretical network containing concepts of interest are confirmed" (Bagozzi, 1982). This implies evaluating the explanatory power of the model, and the significance of paths in the structural model which represent hypotheses to be tested.

As the objective of PLS modeling is to explain variance, predictive ability becomes an important criterion for model evaluation and for assessing the tenability of a theory (Barclay, 1986). This was assessed by the explained variance (R-squared) in the endogenous (dependent) constructs, primarily the utilization of personal computers.

Hypothesis testing consisted of examining the size, sign, and statistical significance of the path coefficients between constructs in the structural model. Although PLS does not require meeting stringent data criteria for estimating model parameters, the application of traditional statistical tests of significance does require meeting the assumptions of multinormality, independence of observations, and interval scaling. Rather than assume that these requirements have been met, a distribution-free approach to significance testing (such as jacknifing) can be utilized.

Jacknifing (Fornell and Barclay, 1983; Tukey, 1958; Wildt, Lanber and Durand, 1982) involves the computation of sample statistics based on several subsamples that overlap in the observations they contain. A 'sample' of values is generated with a distribution which approaches normality, allowing for the calculation of t-statistics. For this analysis the jacknifing routine developed by Fornell and Barclay (1983) was used. The technique involves removing a subset (of the first 'n' responses) from the sample and using PLS to generate path coefficients and related statistics. The first subset is replaced, a subset of the next 'n' responses removed, and the analysis repeated. This continues until all cases (responses) have been removed once from the sample. The t-statistics are then calculated by dividing the mean of each path coefficient by the corresponding standard error.

This concludes the discussion of the research design and data analysis techniques. The data analyses are presented next in chapters four (pilot study) and five (primary study).

CHAPTER 4 - PILOT STUDY

The pilot study (first phase) was used to test the measures for the various constructs. This was deemed necessary, since many of the measurement scales were developed specifically for this study. Once the measures were considered adequate, the structural model (hypotheses) were also examined. A single site was chosen, with a relatively large number of prospective respondents. The objective was to obtain a large enough sample for analysis, while holding other extraneous factors (such as organizational climate) constant.

4.1 Research Site

The organization chosen for the pilot study is mainly involved in the design, manufacture and servicing of products for the space, air and ground transportation industries. The company employs about 1900 individuals in Canada and the United States, and recent annual operating revenues were about $200 million dollars.

Approximately 1500 of the 1900 employees are classified by the company as knowledge workers, and are located in 9 geographically separate divisions. Although the general functions of the divisions are somewhat different, individuals in similar positions between the divisions have relatively similar job tasks.

During the summer of 1986, the organization offered an employee purchase plan which provided financial assistance to individuals who wished to purchase personal computers. The organization arranged for a volume discount from a specific computer retailer, allowing the employees some choice on the actual manufacturer and system configuration. The volume discount was quite substantial, with savings of 20-25% off the suggested retail value. Employees who decided to participate were given a $250.00 grant towards the purchase, and also received a two-year, interest-free loan for the balance of the purchase price (up to a maximum of $2,000.00). If the purchase price was greater than $2,250.00, the employee paid the difference up front. Over one-third of the 1500 knowledge workers(1) eligible for the plan decided to participate.

The policies and procedures for the acquisition and use of personal computers were generated by the head office, with input from the divisions. The support for personal computer use was handled locally by the divisions, under the guidance and direction of the head office. The general perspective adopted was to make personal computer systems readily available to the knowledge workers (both in the office and at home), and then allow individuals to discover their own ways to use the technology for their jobs.

---

(1) In this research 'knowledge workers' include supervisory and managerial staff, as well as individuals who deal primarily with information and decision making. The term is meant to exclude clerical and administrative staff.

4.2 Procedure

In April of 1987 the research instrument was administered to all 567 of the employees who purchased a personal computer. This sample was chosen for two reasons. First, the organization had no list of individuals who used personal computers within the office environment, and no simple way of obtaining one. On the other hand, a list did exist of all the individuals who participated in the purchase program. Second, the organization wished to obtain additional information from the participants of the purchase program which was outside the focus of this study.

It was recognized that this selection of respondents could introduce some systematic bias into the results, since it was possible the sample was not representative of the population of interest. Specifically, the respondents had purchased personal computers and therefore might (as a group) hold more positive attitudes or higher expectations than individuals who had not purchased personal computers. If the majority of the respondents held very positive attitudes toward using personal computers (that is, a highly skewed distribution of responses), it would be difficult to empirically examine the relationships between the attitude components and utilization. Through initial contact with several potential respondents, however, it was believed that this potential for bias was not very significant. Since the organization was unwilling to generate a list of all individuals who used personal computers, it was necessary to decide whether to proceed with the pilot study or to remove the potential for bias by selecting an alternative organization. The potential contributions of the pilot study were considered substantial, and the potential risk for bias was considered slight. For this reason it was decided to proceed with the pilot study with the selected organization.

The data were collected in the following manner. A list of prospective respondents (and the division they worked for) was obtained from the organization. The questionnaires were programmed so that the respondents could complete them interactively using a personal computer. The computer diskettes were then distributed to the respondents through the company's internal mail system, accompanied by a covering letter from the researcher and one from the appropriate Divisional Manager. The questionnaires were distributed in two phases, over a period of four weeks. The completed questionnaires were returned (in sealed envelopes) to a representative at the company's corporate office, where they were held for the researcher. A follow-up letter was sent to non-respondents.

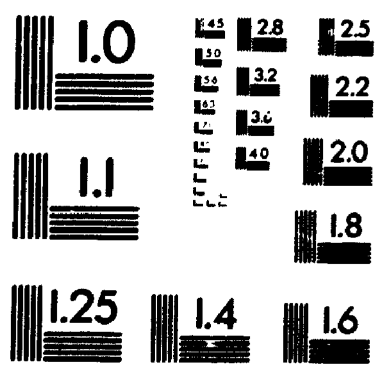
The gross response rate for the study was 62%, and the net response rate (calculated as usable questionnaires divided by possible responses) was slightly over 51%. The difference was accounted for by questionnaires that were not fully completed (that is, the respondent ended the program before completing the questionnaire). The respondents were 80% male and 20% female. Over 67% held undergraduate or graduate degrees. The majority were between 30 and 50 years of age (60%), with the remainder being split roughly between those younger than 30 and those older than

50. About 38% classified their job function as engineer/professional, 27% as managerial/supervisory, 14% as clerical, 11% as staff specialist, and the remainder as executive or technical. Since the focus of this study was knowledge workers, responses from clerical staff were removed prior to the analysis of the data.

To check for the possibility of response bias, ten non-respondents were contacted to ascertain their reasons for not completing the survey questionnaire. Six stated they felt they were too busy to respond, three stated they had recently responded to surveys involving personal computers (for user groups), and one held a personal policy of not responding to any surveys unless they were required to do so by their employer. The ten individuals were also asked to describe their experience with and use of personal computers. Their responses were compared to the results for the respondents, and no indication was found of a difference in experience level or utilization between the respondents and non-respondents.

4.2 Operationalization of Constructs

The research model, developed in chapter two, is repeated once more for the reader in Figure 4 on page 87. The discussion which follows describes the development of the measurement scales used in the pilot study. A short form of the individual indicators (questions) is displayed in Figure 5 on page 88, and the complete measures are provided in Appendix


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

V. A number of changes were made as a result of the pilot study findings; these changes are discussed in section 4.4.1.

Experience with personal computers refers to the experience the individual has with using personal computer systems for job-related tasks. The components of experience (suggested by Cheney, 1984; Raymond, 1985; and Pavri, 1988) include the number of months using a personal computer, the typing skill, and the perceived skill level. These were measured using 5-point, Likert-type (Likert, 1931) questions.

The construct management support for personal computer use refers to the perceived level of support offered by management for the use of personal computers. The scale contains five Likert-type indicators, adapted from the work of Amoroso (1986-a). The measures focus more on technical support than organizational support.

The job-related expectations of personal computer use are the beliefs about the impact of using personal computers on related aspects of the job. This was operationalized using a scale adapted directly from C. Beatty (1986). This scale was based on work conducted by Vroom (1964) and Lawler (1973). Seven measures were developed using a 5-point, Likert-type scale.

The correspondence between job tasks and personal computer use was defined as the perceived extent to which personal computer use may or may not enhance the performance of current job tasks. The five scale items (using

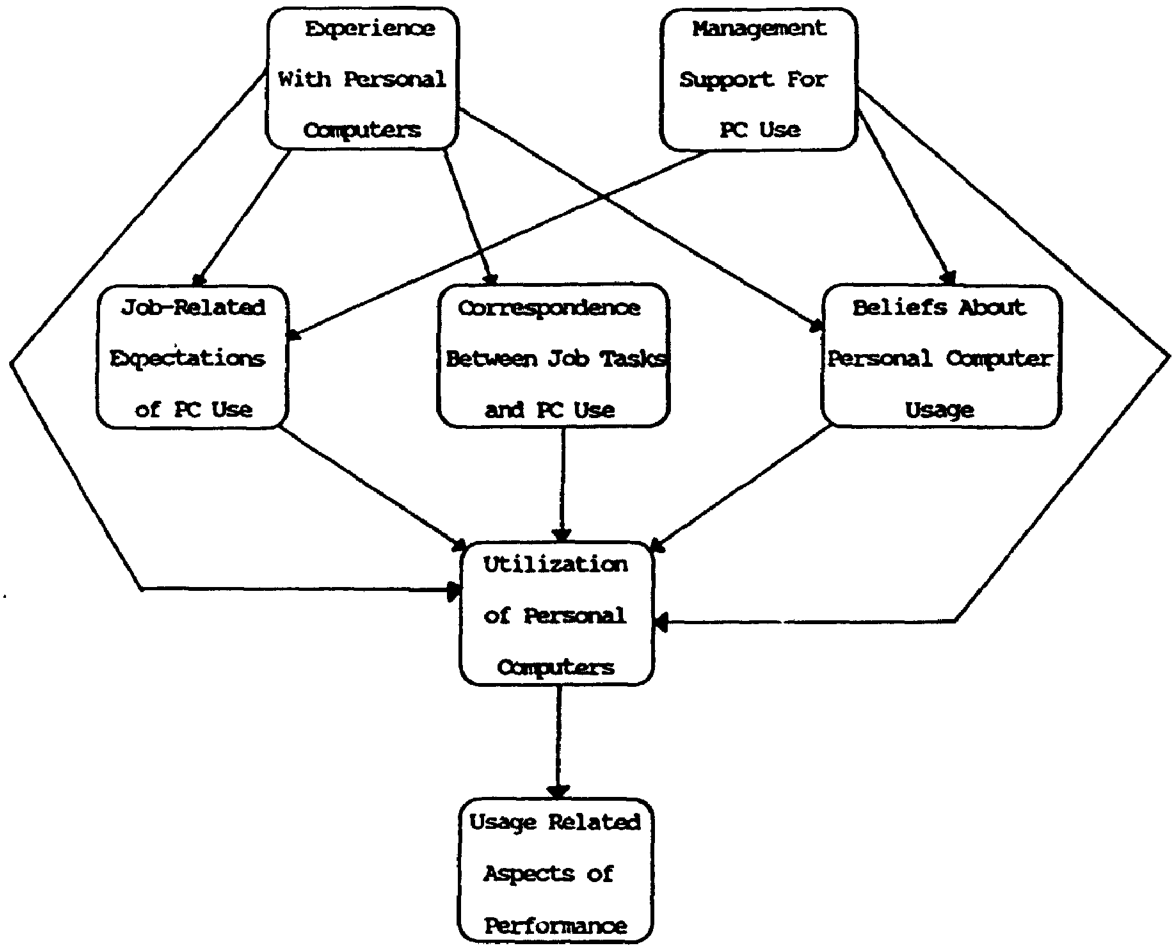


Figure 4. Conceptual Model of Utilization

CONSTRUCT		MEASURE
EXPERIENCE............	EX1	- number of months using a PC
	EX2	- keyboarding skills
	EX3	- general PC skill level
MANAGEMENT SUPPORT....	MS1	- guidance available for selection of hardware and software
	MS2	- assistance available for software problems
	MS3	- instruction available for software
	MS4	- assistance available for hardware difficulties
	MS5	- organization generally supports use of PC's
EXPECTATIONS..........	EP1	- level of challenge on the job
	EP2	- opportunities for preferred job assignments
	EP3	- status
	EP4	- control over own job
	EP5	- communication within department
	EP6	- amount of variety on job
	EP7	- opportunities for more meaningful work
CORRESPONDENCE........	CO1	- decrease time needed for routine job tasks
	CO2	- increase quality of output
	CO3	- increase effectiveness (eg. analysis)
	CO4	- increase quantity of output for same level of of effort
	CO5	- general extent to which use of PC could assist on job
USAGE BELIEFS............	UB1	- using PC's takes too much time from job
	UB2	- PC's make work more interesting
	UB3	- working with PC's is complicated; difficult to understand what is going on
	UB4	- using a PC involves too much time doing mechanical operations (ie. input)
	UB5	- working with PC's is fun
	UB6	- PC can provide information which will lead to better decisions
	UB7	- takes too long to learn how to use a PC to make it worth the effort
UTILIZATION...........	UT1	- average time spent/day using PC for job
	UT2	- frequency of PC use
	UT3	- diversity of software packages used
PERFORMANCE ASPECTS...	PA1	- has been useful for performing current job responsibilities
	PA2	- improved writing skills (quality and quantity of reports and correspondence)
	PA3	- allowed more effective communication with others
	PA4	- increased reliance on PC's for work

Figure 5. Operationalization of Constructs - Pilot Study

a 5-point Likert-type scale) were generated partially through reference to C. Beatty (1986) and Floyd (1986).

The beliefs about personal computer use refers to beliefs about the use of personal computers, such as the time required and the difficulty of understanding. The measurement scale was developed on the basis of work conducted by Howard (1985) and Morrison (1983). Howard's instrument was situation specific in that it was developed with the aid of senior managers who did not use personal computers. Morrison was more concerned with social attitudes toward computers, and used a previously developed instrument to survey a broad range of university students. It was decided that neither instrument was appropriate by itself, and hence the two scales were used as a guide in developing seven items (using a 5-point Likert-type scale) designed to measure the construct.

The utilization of personal computers scale was developed on the basis of work conducted by Cheney (1984) and Raymond (1985). Three dimensions were suggested for the utilization of personal computers, including:

1) the frequency of use;
2) the intensity of use (average amount of use per time period); and
3) the diversity of software packages used.

Since no appropriate instrument with acceptable reliability and validity was located, three items were developed with reference to the dimensions named above. The frequency and intensity of use were measured using Likert-type scales, while the diversity of use was calculated in the pilot study by a simple count of those packages for which the response for extent of use was 'to some extent' or greater (3, 4, or 5 on a 5-point scale).

The job-related aspects of performance construct may take on a number of meanings when viewed from different perspectives within differing contexts. The view adopted here was essentially the perception of the individual concerning the extent to which personal computer use has assisted with specific aspects of his or her job, as well as certain job-related skills. Four indicators (using Likert-type format) were developed for the pilot study.

4.4 Test of the Measures Employed

The test of the measures proceeds as follows: 1) test the convergent validity (including reliability) and 2) test the discriminant validity of the measurement scales.

The test of the measurement model (measures) was conducted with the total sample. All responses from clerical staff were removed, as were cases which had missing values for any of the measurement scale items. The resulting sample size was 216. The data were analysed using Partial Least Squares (PLS).

One of the decisions required with PLS is whether to model the relations between each construct and its associated indicators as being formative or reflective (Fornell, 1984). A number of factors can influence the decision, but basically it rests on the confidence the researcher has in how well the chosen indicators measure the construct. For example, if the construct is known to be unidimensional and the measurement scale has been previously tested for reliability and validity, the measures would be modeled as reflactive. Here the reseacher anticipates that the true score for the construct will be <u>reflected</u> by the indicator scores.

When the researcher is less confident that the indicators measure a unidimensional construct, formative indicators should be used. In this situation the construct is <u>formed</u> by the corresponding indicators, within the context of the overall conceptual model. This allows for the inclusion of constructs which may be of unknown dimensionality (Lohmoller, 1981). This is particularly useful in earlier stages of research into a topic area.

For this study, two of the constructs were modeled with formative indicators. Both the utilization of personal computers and experience with personal computers were believed to be of unknown dimensionality. Also, no previously tested measurement scales that were suitable for the research were discovered. The chosen indicators therefore form the construct within the context of the entire model. All remaining constructs were modeled with reflective indicators.

4.4.1 CONVERGENT VALIDITY

The test for convergent validity followed the procedure outlined in the previous chapter (section 3.5.1). The factor loadings were obtained for each of the indicators and their respective constructs. Once again, the general rule of thumb is that factor loadings greater than .7 are desired. The composite scale reliability was also calculated for each of the measurement scales. This value is comparable to Cronbach's alpha (Cronbach, 1951), and for exploratory research values greater than .7 should be obtained (Nunnally, 1978). The final test for convergent validity was the average variance extracted for each of the constructs. As suggested by Fornell and Larcker (1981), this should be greater than .5. The three types of convergent validity measures are displayed in Figure 6 on page 93.

When problems are encountered in the measurement model (such as factor loadings less than .7), it is necessary to decide whether to leave the measures as they are or to revise the measurement model. The decisions are based in part on how close the psychometric properties of the measures are to the suggested standards, and partly on the objectives of the research s dy.

There are no standard rules for revising the measurement model. Generally there exists a trade-off between the desire for valid and reliable measures on the one hand, and capturing as much of a construct as possible on the other. For exploratory studies, it is generally accepted practice

Construct/ Measure	Factor Loading	Scale Reliability	Variance Extracted
Experience		.84	.63
EX1	.82		
EX2	.65		
EX3	.91		
Management Support		.90	.62
MS1	.74		
MS2	.86		
MS3	.77		
MS4	.81		
MS5	.80		
Expectations		.79	.36
EP1	.61		
EP2	.50		
EP3	.62		
EP4	.56		
EP5	.43		
EP6	.67		
EP7	.74		
Correspondence		.87	.58
CO1	.70		
CO2	.79		
CO3	.74		
CO4	.77		
CO5	.81		
Usage Beliefs		.79	.37
UB1	.68		
UB2	.67		
UB3	.58		
UB4	.55		
UB5	.52		
UB6	.65		
UB7	.55		
Utilization		.81	.59
UT1	.79		
UT2	.79		
UT3	.73		
Performance Aspects		.81	.51
PA1	.73		
PA2	.72		
PA3	.73		
PA4	.68		

Figure 6. Original Measurement Model - Pilot Study

to relax the requirements slightly in an effort to gain as much understanding as possible. With more formal tests of hypotheses or the development of measurement scales, it is necessary to ensure that high levels of reliability and validity are achieved (Nunnally, 1978).

The process of revising the model involved examining each of the indicators for each of the constructs in turn. For those with loadings of less than .7, the rationale for either retaining them or removing them is provided. The process of changing the model was iterative, since changes made to one scale can effect the loadings of indicators for a different construct.

After a number of changes had been made to the measures, it was believed that the remaining measurement model was adequate for the purposes of the study. The three types of convergent validity measures are displayed for the revised measurement model in Figure 7 on page 95. The rationale for the changes follows.

The measures for the <u>experience</u> construct in the original model showed acceptable levels of the portion of variance extracted (.63) and the scale reliability (.84). The second measure (EX2 - keyboarding skills) had a factor loading of .65, which is slightly below the guideline of .7. It was decided that keyboarding skills were important to the experience construct, and hence the item was retained.

Construct/ Measure	Factor Loading	Scale Reliability	Variance Extracted
Experience		.83	.64
EX1	.83		
EX2	.66		
EX3	.90		
Management Support		.88	.62
MS1	.66		
MS2	.83		
MS3	.78		
MS4	.82		
MS5	.83		
Expectations		.79	.44
EP1	.68		
EP2	.57		
EP3	.65		
EP6	.67		
EP7	.74		
Correspondence		.87	.58
CO1	.70		
CO2	.79		
CO3	.74		
CO4	.77		
CO5	.81		
Usage Beliefs		.77	.45
UB1	.72		
UB3	.64		
UB4	.63		
UB7	.70		
Utilization		.82	.59
UT1	.79		
UT2	.80		
UT3	.73		
Performance Aspects		.80	.51
PA1	.73		
PA2	.71		
PA3	.73		
PA4	.68		

Figure 7. Revised Measurement Model - Pilot Study

For management support, the portion of variance extracted (.62) and measurement scale reliability (.90) were also acceptable. All of the individual items had factor loadings greater than .70, and therefore no changes were made to the measurement scale.

The original measurement scale for expectations revealed a number of problems. The factor loadings for the six indicators ranged from .43 (EP5 - control over own job) to .74 (EP7 - opportunities for more meaningful work). The measurement scale reliability was acceptable at .79, but the portion of variance extracted was only .36.

Keeping in mind that this scale was adapted from one developed for CAD operators (C. Beatty, 1986), it is possible that EP4 (control over own job) is more appropriate for respondents with more technical job tasks. With EP5 (communication in my department) the emphasis is on the department, while the remaining items focus on the job of the individual. For these reasons the two items (EP4 and EP5) were removed. Although the factor loadings for four of the remaining items were also less than .70, no justification could be found for removing them and hence they were retained. In the revised measurement model (with EP4 and EP5 removed), the factor loadings for three of the remaining indicators did increase. The loadings for the remaining five measures in the revised measurement model ranged from .57 to .74, with a measurement scale reliability of .79 and portion of variance extracted of .44. Although the psychometric properties of the resulting scale were not as strong as desired, they were still reasonably good considering the scale was adapted from a different context.

The correspondence scale consisted of five indicators, and the factor loadings ranged from .70 to .81. The scale reliability was .87 and the portion of variance extracted was .58. No alterations were necessary, and the scale was left intact.

The original beliefs about personal computer use measurement scale contained seven indicators, with factor loadings ranging from .52 to .68. The scale reliability was reasonable at .82, but the portion of variance extracted was only .37. This illustrates the sensitivity of the scale reliability measure to the number of indicators in the scale. As with Cronbach's alpha (Cronbach, 1951), the value of the scale reliability increases as the number of indicators increases. In this situation (seven indicators), the portion of variance extracted becomes a better indicator of convergent validity.

An examination of the items used to measure beliefs about personal computer usage revealed that three of the indicators were not consistent with the remaining four. Two of these (AT2 - personal computers make work interesting and AT5 - working with personal computers is fun) were actually measuring attitudes toward the object (personal computers). The third (AT6 - using a personal computer can provide information that will lead to better decision making) was not related to the actual operation of personal computers, while the remainder were. It appeared that the construct, as originally defined, was at too high a level. That is, the corstruct may have been multidimensional. For these reasons the three indicators (AT2, AT5 and AT6) were removed. The factor loadings for the remaining indicators in the revised measurement model ranged from .63 to .72, and the portion of variance extracted was .45. Again the scale was weaker than desired, but considered adequate to continue with the analysis. The remaining indicators measured only a portion of the construct as originally defined, however, suggesting that the meaning of the construct was altered somewhat in the revised measurement model.

The measurement scale for utilization appeared adequate in the original model. The factor loadings ranged from .73 to .79, the scale relibility for the three indicator scale was .81, and the portion of variance extracted was .59. The scale was left intact, although another indicator (relating to the sophistication level of use) was added for the second phase of the research.

The final measurement scale was aspects of performance. The factor loadings for the four indicators ranged from .68 to .73, the scale reliability was .81, and the portion of variance extracted was .51. With these results the scale could be considered to exhibit adequate psychometric properties with respect to convergent validity.

4.4.2 DISCRIMINANT VALIDITY

Discriminant validity indicates the extent to which a given construct is different from other constructs. Discriminant validity was assessed within the PLS framework as suggested by Fornell, Tellis and Zinkhan (1982).

One criterion for discriminant validity is that the correlations between constructs be significantly different from unity (see Figure 8 on page 100 for a correlation matrix of latent variables for the revised measurement model). The correlations among constructs were examined and none appeared to be so highly intercorrelated as to be the same constructs. The highest correlation observed was .56 (between correspondence and performance aspects), which is significantly different from a correlation of 1.00.

A related concern was whether the three components of attitudes were in fact separate and distinct. The highest correlation observed between the three components was .36 (correspondence and operations), which also is significantly different from unity. It was anticipated that the components of attitudes would be related, and hence the observed correlations were as expected.

An additional criterion for discriminant validity is that each indicator should load more strongly on its associated construct than on any other

	C1	C2	C3	C4	C5	C6
C1	1.00					
C2	.09	1.00				
C3	.22	.16	1.00			
C4	.39	.18	.35	1.00		
C5	.43	.06	.18	.36	1.00	
C6	.55	.09	.27	.31	.27	1.00
C7	.45	.23	.34	.56	.36	.53

C1 - Experience
C2 - Management Support
C3 - Expectations
C4 - Correspondence
C5 - Usage Beliefs
C6 - Utilization
C7 - Performance Aspects

Figure 8. Correlation Matrix - Pilot Study

construct. For example, EX3 (general personal computer skill level) should load stronger with experience than with any of the other constructs. This criterion was tested within PLS by examining the factor structure, which is a listing of the loadings of all indicators on every construct. Figure 9 on page 101 displays the factor structure obtained for the revised measurement model. The numeric values represent the loadings of each indicator on each of the seven constructs. For example, EX1 (number of months using a personal computer) had a loading of .82 on experience, .15 on management support, and so on. The test was conducted, and all of the indicators satisfied the criterion.

MEASURE	C1	C2	C3	C4	C5	C6	C7
EX1	82	15	16	36	35	44	31
EX2	66	3	22	24	27	35	35
EX3	90	3	19	32	39	52	42
MS1	1	66	1	20	3	2	21
MS2	1	83	10	15	2	0	14
MS3	13	78	9	15	8	8	21
MS4	8	82	11	10	3	10	16
MS5	6	83	19	16	6	10	20
EP1	16	15	68	22	4	17	27
EP2	16	5	57	19	13	13	15
EP3	13	17	65	29	10	17	27
EP6	11	3	67	16	10	17	19
EP7	17	9	73	27	21	23	19
CO1	29	18	22	70	18	21	32
CO2	33	10	30	79	20	27	50
CO3	15	13	31	74	26	19	42
CO4	25	10	27	77	33	19	38
CO5	37	15	26	80	37	28	48
UB1	33	11	23	34	72	16	35
UB3	28	6	4	15	64	25	19
UB4	26	3	9	26	63	11	24
UB7	27	-4	12	21	70	18	19
UT1	37	6	23	30	20	77	45
UT2	36	16	21	29	21	80	49
UT3	53	-1	19	13	20	73	27
PA1	49	19	32	58	47	47	74
PA2	32	9	26	31	20	34	72
PA3	22	16	8	30	12	36	73
PA4	16	23	28	32	16	28	68

C1 - Experience
C2 - Management Support
C3 - Expectations
C4 - Correspondence
C5 - Usage Beliefs
C6 - Utilization
C7 - Performance Aspects

Figure 9. Factor Structure - Pilot Study

One final criterion for discriminant validity is that the variance shared between any two constructs be lower than the variance shared between either of these two constructs and their respective measures. Figure 10 on page 103 displays the variance extracted for each of the constructs, as well as the path coefficients which correspond to the eleven hypotheses. To apply the previously mentioned criterion for discriminant validity, it is ncessary to ensure that the average variance extracted is greater for any two (related) constructs than the path coefficient between them.

For example, the average variance extracted for experience (C1) was .64, and for correspondence (C4) it was .58. The path coefficient between experience and correspondence was .39, which is less than .64 and .58. Therefore, for this pair of constructs (C1 and C4) the criterion for discriminant validity has been satisfied.

An examination of the remaining path coefficients and average variances extracted reveals one case where this criterion for discriminant validity was not satisfied. Specifically, the path coefficient between C6 (utilization) and C7 (performance aspects) was .53, while the variance extracted for performance aspects was .51. This suggests that the performance construct, as measured, shares more variance with the utilization construct than it does with its own measures. This in turn suggests that the measurement scales have failed to clearly differentiate the two constructs. Since the utilization measures deal with relatively common aspects of utilization, it appeared that the measures for

VARIANCE EXTRACTED		.64	.62	.44	.58	.45	.59	.51
	CONSTRUCT	C1	C2	C3	C4	C5	C6	C7
.64	C1	—	—	.21	.39	.43	.49	—
.62	C2	—	—	.14	—	.02	.02	—
.44	C3	—	—	—	—	—	.13	—
.58	C4	—	—	—	—	—	.07	—
.45	C5	—	—	—	—	—	.01	—
.59	C6	—	—	—	—	—	—	.53
.51	C7	—	—	—	—	—	—	—

C1 Experience
C2 Management Support
C3 Expectations
C4 Correspondence
C5 Usage Beliefs
C6 Utilization
C7 Performance Aspects

Figure 10. Variance Extracted and Path Coefficients - Pilot Study

performance needed to be changed. An examination of the indicators suggested that they might not capture the construct as intended. The indicators were quite general and seemed to omit a number of potentially important performance aspects. For this reason it was decided to develop revised measures for the second phase of the study.

This concluded the test of measures from the pilot study. In general the measures were adequate, lending confidence in their use for the second phase of the research. It was decided that the measurement model could be improved by adding one indicator for the utilization construct (sophistication of use), as well as by developing indicators of more specific, usage-related aspects of performance.

4.5 Structural Model Results - Test of Hypotheses

Once the measures have been tested, the next step is to test the hypothesized relations within the structural model. This involves examining the magnitude of the path coefficients (relations between constructs) and also testing the path coefficients to determine whether or not they are statistically significant.

The path coefficients obtained from PLS are identical to standardized regression coefficients. If normality of the data are assumed, they can be tested parametrically. When the normality assumption is not justified or is questionable, a non-parametric technique such as jackknifing can be used.

Jacknifing (Fornell and Barclay, 1983; Tukey, 1958; Wildt, Lanber and Durand, 1982) involves the computation of sample statistics based on several subsamples that overlap in the observations they contain. A sample of values is generated with a distribution approaching normality, which allows for the calculation of t-statistics. For this analysis the jacknifing routine developed by Fornell and Barclay (1983) was employed.

The t-statistics were calculated by dividing the mean of each path coefficient (from the sample) by the corresponding standard error. The path coefficients, t-statistic values and significance levels are displayed in Figure 11 on page 106.

The results from the pilot study showed support for eight of the hypothesized relations. One-third of the variance in the major dependent variable, utilization, was explained by the model.

The primary purpose of the research was to examine the relative strength of relations involving different components cf attitudes toward using personal computers. The results from the pilot study indicated that expectations had a positive influence on utilization, and correspondence also had a (weaker) positive influence. However, there was no support for the hypothesis that beliefs about personal computer usage had an impact on actual utilization.

Hypothesis	Path Coefficient	t	Significance level
H1: Experience to Utilization	.49	7.24	.0005
H2: Management Support to Utilization	.02	0.50	NS
H3: Expectations to Utilization	.13	4.48	.0005
H4: Correspondence to Utilization	.07	1.78	.1000
H5: Usage Beliefs to Utilization	.01	0.15	NS
H6: Experience to Expectations	.21	7.24	.0005
H7: Experience to Correspondence	.39	15.28	.0005
H8: Experience to Usage Beliefs	.43	21.78	.0005
H9: Management Support to Expectations	.14	4.37	.0050
H10: Management Support to Usage Beliefs	.02	0.82	NS
H11: Utilization to Performance Aspects	.53	26.22	.0005

Construct	Amount of Variance Explained
Expectations	.07
Correspondence	.15
Usage Beliefs	.19
Utilization	.33
Performance Aspects	.28

Figure 11. Results from PLS Analysis - Pilot Study

The results involving experience with personal computers were as hypothesized. The direct influence of experience on utilization was very strong (.49), much more so than that observed from any of the attitude components. These path coefficients ranged from a low of .01 for hypothesis 5 (usage beliefs to utilization) to a high of .13 for the third hypothesis (expectations to utilization). Experience also displayed a positive influence on each of the attitude components (.21 with expectations, .39 with correspondence and .43 with usage beliefs).

The relations involving management support were not as hypothesized, with the exception of the relation between management support and expectations (the path coefficient was was .14, and the significance level was .005). There was no support for a positive relation between management support and beliefs about personal computer usage (path coefficient of .02), nor was there support for a direct relation between management support and utilization (path coefficient of .02).

The relation between utilization and aspects of performance was strong and positive (the path coefficient was .53), as hypothesized. This supports the hypothesis that the more individuals use personal computers, the greater is their perception of the positive impact on their job performance. The test of discriminant validity for the measures, however, revealed problems with the scale for performance aspects. More specifically, the measures did not adequately differentiate between utilization and performance. For this reason less confidence may be placed in the magnitude of the path coefficient obtained, and the observed result needs to be interpreted with caution.

4.6 Summary of Pilot Study Contributions

The pilot study provided a number of contributions to the research effort. It enabled the data collection technique and data analysis techniques to be tested. It provided a suitable test for the measurement model. It also allowed the research model to be tested, to determine if the effects being investigated (such as the impact of expectations on utilization) were large enough to be detected by the measures employed. It also provided the beginning for a relatively large database of information relating to the use of personal computers by knowledge workers.

The use of diskette-based questionnaires in the pilot study was considered a success. The cost was comparable with paper questionnaires, and the time savings in transferring data from the questionnaires to a database for analysis were substantial. No difficulties were encountered by the respondents in using the questionnaires, and errors caused by transmitting data from the questionnaires (coding errors) were eliminated.

A number of concerns were raised by respondents, however, relating to the length of the questionnaire and the confidentiality of responses. The questionnaire used in the pilot study took at least 35 - 45 minutes to complete, and two individuals contacted the researcher by telephone and expressed concern about having the responses delivered to a representative at the organization. It was believed that these two factors may have adversely affected the response rate. For the second phase of the study, the questionnaire was shortened substantially, and all responses were returned to the researcher directly. Other aspects of the data collection approach (such as the format, content and timing of correspondence) seemed to work well and were retained for the primary study.

The data analysis technique (PLS) was also judged to be appropriate, and was it decided to continue using it for the second phase of the study. No major difficulties were encountered in the use of PLS, and the benefits (such as the ability to test the measurement model and structural model simultaneously) were substantial.

The test of the measurement model revealed three potential problems. Two of the measurement scales did not surpass the standard of .5 for the average variance extracted, although both did show acceptable levels for the composite scale reliability. These were the scales for expectations (average variance extracted - .44; composite scale reliability - .79) and usage beliefs (average variance extracted - .45; composite scale reliability - .77). This indicated that the measurement scales would be weak (in terms of convergent validity) for hypothesis testing involving relations that have a small effect size (Sawyer and Ball, 1981). Since this study was largely exploratory, however, the (revised) measurement scales were considered to be adequate in terms of convergent validity and could be used for the second phase.

With respect to discriminant validity, the tests conducted showed that the path coefficient between utilization and performance aspects was higher than the average variance extracted for the performance aspects construct. This led to the conclusion that the measures employed for the performance construct did not adequately differentiate between utilization and performance, and new measures for performance would need to be developed for the second phase.

Another, less formal test of the measures was conducted. Specifically, each of the measurement scales were examined from a face validity perspective to ensure that the indicators captured the meaning of the construct, as defined. In the case of utilization, it was decided that one dimension of utilization which had been omitted in the original scale was a measure of the sophistication of use. A measure of sophistication was subsequently developed and added for the second phase of the research. With respect to usage beliefs, three of the original seven indicators were removed from the scale. The remaining indicators did not appear to measure the construct as originally defined, and it was believed that the original construct may have been multidimensional. This meant that the definition of the construct needed to be changed somewhat, to bring it more in line with the remaining indicators. Specifically, usage beliefs was redefined at a lower level of abstraction, and subsequently dealt with beliefs about more technical use (such as the time required and the difficulty of use).

The test of the structural model revealed that not all of the relations were supported as hypothesized. Management support was not found to influence either usage beliefs or utilization. Also, there was no statistically significant relation between usage beliefs and utilization. All of the remaining eight hypotheses were supported by the analysis results. With respect to the predictive power of the model, thirty-three percent of the variance was explained in utilization. The model was not designed for the purpose of predicting utilization, but the R-squared value obtained provided confidence that the factors chosen did in fact have measurable impacts on the utilization of personal computers. The path coefficients suggested that experience was the most dominant factor.

This chapter discussed the first phase of the research study, from a description of the research site to the results of the data analysis. The following chapter provides a similar examination of the second phase, and also compares the results obtained from the pilot and primary studies.

CHAPTER 5 - PRIMARY STUDY

This chapter presents the findings from the second phase of the research (primary study). First some preliminary analysis is conducted, to provide a profile of the respondents. Next the operationalization of the constructs is displayed, to illustrate the changes from the pilot study. The remaining analysis proceeds as follows:

1. test of the reliability and convergent validity of the measurement scales;
2. test of the discriminant validity of the measurement scales; and
3. test of the hypotheses and the predictive power of the model.

5.1 Preliminary Analysis

The data for the second phase of the study were collected from respondents in eight organizations (see Appendix I for a list of participating enterprises). These included two government agencies, two manufacturers of high technology equipment, a high technology research and development firm, a manufacturer of trucks, the administrative head office of a mining and resource company, and a devloper of customized computer software. In all but one case, a specific operational unit of each enterprise was chosen for the administration of the questionnaire. One organization was small enough that all potential respondents were contacted. For the rest, all potential respondents within the designated organizational unit received the research instrument.

Although a total of 346 responses were returned, not all were usable for the data analyses. Of the total responses, 2 were discarded because of damaged computer diskettes, 37 questionnaires were not fully completed, and 69 of the remaining respondents classified their jobs as clerical/administrative. This left 238 usable responses, from a possible sample of 365 (434 - 69).

The gross response rates for the organizations participating in the second phase of the study ranged from 63% to 100%, and the overall gross response rate was 80% (see Figure 12 on page 114 for a breakdown by organization). The overall net response rate (calculated as usable questionnaires divided by possible responses) was 65% (238/365). The sample was approximately 70% male and 30% female. Over 65% held undergraduate or graduate degrees. The majority were between 30 and 50 years of age (54%), with 31% reporting ages less than 30 and 15% over 50. About 30% classified their job function as engineer/professional, 34% as managerial/supervisory, 24% as staff specialist, and the remainder as executive or technical.

5.2 Test of the Measurement Model

The revised operationalization of constructs is illustrated in Figure 13 on page 116. The changes from the pilot study measurement model include the addition of one indicator for utilization (UT4 - sophistication) as well as the replacement of the aspects of performance indicators with items believed to be more closely related to the intended concept of

ORGANIZATION	NUMBER DELIVERED	NUMBER RETURNED	GROSS PERCENT	NOT USABLE	NET PERCENT
A	12	12	100	1	92
B	34	26	76	3	68
C	103	82	80	12	68
D	13	11	85	–	85
E	93	86	92	12	80
F	24	22	92	4	75
G	48	40	81	1	79
H	107	67	63	5	58
TOTAL:	434	346	80	38	72*

* Note: 6 questionnaires were undeliverable, as the respondents had left their respective organizations. The net response rate was therefore calculated as (308/428), or 72%.

Figure 12. Response Rates by Organization - Primary Study

performance (PA1 through PA7). All remaining indicators were the same as in the pilot study.

The test of the measurement model proceeded in the same fashion as was described in chapter four. The individual factor loadings, measurement (composite) scale reliabilities, and portion of variance extracted are displayed in Figure 14 on page 117.

In general the results from the tests for convergent validity and reliability were quite good. Only one indicator (UB3 - using a personal computer can involve too much time doing mechanical operations to allow sufficient time for analysis) had a very low factor loading at .47.

The measurement scale reliabilities for the constructs ranged from .76 (for usage beliefs) to .89 (for correspondence), with only two being lower than .80. Recall that the measurement scale reliabilities can be interpretated similarily to Cronbach's alpha coefficients, and Nunnally (1978) suggests .70 is sufficient for exploratory work. Also, the measurement scale reliability value is sensitive to the number of indicators used, with more indicators tending to increase the reliability. Considering the small number of indicators for each of the scales with scale reliabilities less than .80 (three and four respectively, for experience and usage beliefs), the measurement scale reliabilities were very strong.

CONSTRUCT	MEASURE
EXPERIENCE............	EX1 - number of months using a PC
	EX2 - keyboarding skills
	EX3 - general PC skill level
MANAGEMENT SUPPORT....	MS1 - guidance available for selection of hardware and software
	MS2 - assistance available for software problems
	MS3 - instruction available for software
	MS4 - assistance available for hardware difficulties
	MS5 - organization generally supports use of PC's
EXPECTATIONS..........	EP1 - level of challenge on the job
	EP2 - opportunities for preferred job assignments
	EP3 - status
	EP6 - amount of variety on job
	EP7 - opportunities for more meaningful work
CORRESPONDENCE........	CO1 - decrease time needed for routine job tasks
	CO2 - increase quality of output
	CO3 - increase effectiveness (eg. analysis)
	CO4 - increase quantity of output for same level of of effort
	CO5 - general extent to which use of PC could assist on job
USAGE BELIEFS............	UB1 - using PC's takes too much time from job
	UB3 - working with PC's is complicated; difficult to understand what is going on
	UB4 - using a PC involves too much time doing mechanical operations (ie. input)
	UB7 - takes too long to learn how to use a PC to make it worth the effort
UTILIZATION...........	UT1 - average time spent/day using PC for job
	UT2 - frequency of PC use
	UT3 - diversity of software packages used
	UT4 - sophistication of use (number and type of applications)
PERFORMANCE ASPECTS...	PA1 - has improved the quality of reports produced
	PA2 - reduced time required for more routine tasks
	PA3 - allowed more effective communication with others
	PA4 - improved writing skills (letters, reports)
	PA5 - reduced reliance on other individuals within the organization
	PA6 - improved the quality of analysis performed
	PA7 - allowed for more creativity in dealing with different aspects of job

Figure 13. Operationalization of Constructs - Primary Study

Construct/ Measure	Factor Loading	Scale Reliability	Variance Extracted
Experience		.77	.55
EX1	.61		
EX2	.59		
EX3	.96		
Management Support		.88	.60
MS1	.84		
MS2	.81		
MS3	.72		
MS4	.78		
MS5	.69		
Expectations		.89	.61
EP1	.68		
EP2	.84		
EP3	.78		
EP4	.80		
EP5	.80		
Correspondence		.89	.61
CO1	.67		
CO2	.81		
CO3	.77		
CO4	.80		
CO5	.84		
Usage Beliefs		.76	.46
UB1	.76		
UB2	.73		
UB3	.47		
UB4	.70		
Utilization		.83	.54
UT1	.71		
UT2	.84		
UT3	.67		
UT4	.72		
Performance Aspects		.88	.52
PA1	.77		
PA2	.72		
PA3	.73		
PA4	.59		
PA5	.69		
PA6	.74		
PA7	.77		

Figure 14. Measurement Model - Primary Study

The portion of variance extracted was greater than the .50 standard (Fornell and Larcker, 1981) for all but one of the measurement scales. The only exception was beliefs about personal computer usage, which showed a value of .46. This indicates a weakness in the usage belief measures, and implies that future studies could be enhanced by developing better measures for the construct. As mentioned above, one indicator (UB3) displayed a relatively weak loading. If it was removed, the portion of variance extracted for the scale would increase to over .50 (since all of the remaining factor loadings for this scale are greater than .70). This suggests that UB3 should be replaced or revised in future research.

The tests for discriminant validity were also conducted as described in chapter four. The factor loadings were examined for each indicator on every construct, to ensure that the variance shared between each indicator and its construct was larger than the variance shared with the same indicator and any other construct. Figure 15 on page 119 displays the factor structure for the primary study.

It was also verified that the average variance extracted for each related construct was greater than the path coefficient between the two related constructs and any related construct (see Figure 16 on page 121 for a listing of the variance extracted for each of the constructs, and the path coefficients between any pair of related constructs). In the pilot study the path coefficient between utilization and performance aspects was greater than the average variance extracted for performance aspects (see Figure 10 on page 103). For the primary study, the path coefficient from

C1 - Experience

C2 - Management Support

C3 - Expectations

C4 - Correspondence

C5 - Usage Beliefs

C6 - Utilization

C7 - Performance Aspects

MEASURE	C1	C2	C3	C4	C5	C6	C7
EX1	60	10	10	26	17	38	37
EX2	58	7	28	22	27	22	34
EX3	97	-12	20	59	41	55	46
MS1	0	84	9	2	14	-7	12
MS2	-13	82	11	6	7	-11	12
MS3	-3	72	5	-4	9	-13	5
MS4	-3	78	7	0	11	-2	11
MS5	-4	69	7	-7	5	-6	10
EP1	11	-1	68	30	10	19	35
EP2	26	12	84	38	13	16	49
EP3	13	16	78	40	-1	21	38
EP6	18	1	79	44	12	20	49
EP7	23	8	80	40	11	23	46
CO1	19	1	15	66	26	26	30
CO2	24	0	36	81	10	33	43
CO3	14	7	47	77	9	20	48
CO4	19	2	42	80	20	28	45
CO5	39	0	49	64	31	47	56
UB1	26	15	11	24	76	16	26
UB3	38	4	5	10	73	25	24
UB4	9	15	7	20	47	6	21
UB7	30	6	10	22	70	20	32
UT1	39	-15	20	34	19	72	32
UT2	41	-5	25	37	27	77	47
UT3	44	-10	10	23	16	73	29
UT4	42	-3	19	31	17	76	37
PA1	44	11	40	51	33	42	85
PA2	37	15	43	51	37	37	75
PA3	27	14	46	44	23	29	59
PA4	30	-5	28	25	15	28	56
PA5	32	6	31	25	23	25	51
PA6	36	12	42	41	24	35	69
PA7	40	9	53	36	26	38	77

Figure 15. Factor Structure - Primary Study

utilization to performance aspects was .49, while the average variance extracted was .54 for utilization and .52 for performance aspects. In all other cases this criterion for discriminant validity was also satisfied.

Finally, the correlations between constructs (latent variables) were examined to ensure that no two constructs were so highly intercorrelated as to be the same construct (see Figure 17 on page 122 for the correlation matrix). These tests were conducted, and in all cases the criteria for discriminant validity were satisfied.

In summary, the validity and reliability of the measurement scales developed and tested in the pilot study were confirmed by the pilot study results (excluding indicator UB3 mentioned earlier).

5.3 Tests of the Hypotheses

Once the measurement model was tested and found adequate, the path coefficients were examined and tested for statistical significance. This was accomplished by using jackknifing to calculate t-statistic values, as described in chapter four. The path coefficients, t-statistics and significance levels are displayed in Figure 18 on page 123.

To aid in the interpretation of the results, each of the hypotheses developed in chapter two is stated once more in this section. The results for the pilot study and primary study are compared, (see Figure 19 on page

VARIANCE EXTRACTED		.55	.60	.61	.61	.46	.54	.52
	CONSTRUCT	C1	C2	C3	C4	C5	C6	C7
.55	C1	—	—	.25	.33	.42	.43	—
.60	C2	—	—	.12	—	.15	.09	—
.61	C3	—	—	—	—	—	.03	—
.61	C4	—	—	—	—	—	.27	—
.46	C5	—	—	—	—	—	.04	—
.54	C6	—	—	—	—	—	—	.49
.52	C7	—	—	—	—	—	—	—

C1 Experience
C2 Management Support
C3 Expectations
C4 Correspondence
C5 Usage Beliefs
C6 Utilization
C7 Performance Aspects

Figure 16. Variance Extracted and Path Coefficients - Primary Study

	C1	C2	C3	C4	C5	C6
C1	1.00					
C2	-.06	1.00				
C3	.24	.10	1.00			
C4	.33	.02	.50	1.00		
C5	.42	.12	.12	.26	1.00	
C6	.55	-.10	.26	.43	.28	1.00
C7	.50	.13	.57	.56	.37	.49

C1 - Experience
C2 - Management Support
C3 - Expectations
C4 - Correspondence
C5 - Usage Beliefs
C6 - Utilization
C7 - Performance Aspects

Figure 17. Correlation Matrix - Primary Study

124 for a summary of the path coefficients obtained from both studies), and an interpretation provided.

The results from the analysis of the primary study gave support for nine of the eleven hypotheses. Thirty-eight percent of the variance was explained in the major dependent variable, utilization. Although some differences were noted between the pilot study and the primary study, the general findings were relatively consistent.

H1: The greater the level of Personal Computer Experience, the greater the Utilization of Personal Computers.

Hypothesis	Path Coefficient	t	Significance level
H1: Experience to Utilization	.43	8.45	.0005
H2: Management Support to Utilization	-.09	-3.95	NS
H3: Expectations to Utilization	.03	1.01	NS
H4: Correspondence to Utilization	.27	10.81	.0005
H5: Usage Beliefs to Utilization	.04	2.25	.0500
H6: Experience to Expectations	.25	8.24	.0005
H7: Experience to Correspondence	.33	8.33	.0005
H8: Experience to Usage Beliefs	.42	8.43	.0005
H9: Management Support to Expectations	.12	4.66	.0050
H10: Management Support to Usage Beliefs	.15	6.55	.0005
H11: Utilization to Performance Aspects	.49	21.33	.0005

Construct	Amount of Variance Explained
Expectations	.07
Correspondence	.11
Usage Beliefs	.19
Utilization	.38
Performance Aspects	.24

Figure 18. Results From PLS Analysis - Primary Study

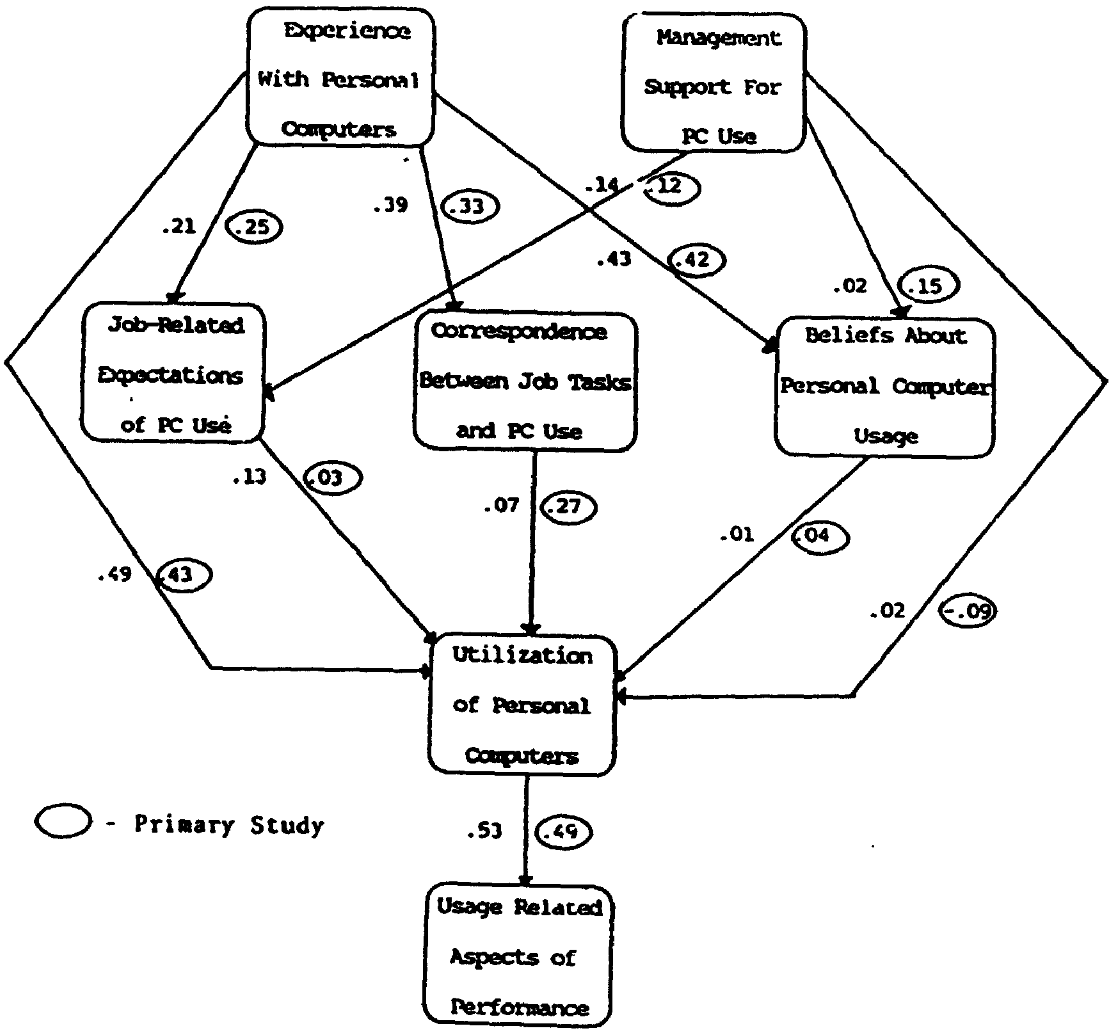


Figure 19. Path Coefficients From Pilot and Primary Studies

The strongest relationship with utilization was with experience; the path coefficients from experience to utilization were .43 and .49 for the pilot and primary studies respectively. The strong observed relation was expected; it stands to reason that individuals who have used personal computers for a period of time and have achieved a reasonable skill level will continue to use them. This was consistent with the findings of Amoroso (1986-a) as well as Lee (1986).

H2: The greater the perceived Management Support for Personal Computer Use, the greater the Utilization of Personal Computers.

The most unexpected results from the research were the observed path coefficients for the relation between management support and utilization. No direct relation was observed between the perception of management support and utilization, for either the pilot study or the primary study. The path coefficients were .02 and -.09 for the pilot study and primary study respectively. It is necessary, however, to keep in mind the type of management support measured. Most of the items addressed support of a technical nature (such as assistance with hardware and software). Also, the distribution of respondents (in terms of personal computer experience) tended to be skewed toward the high end (greater experience). One explanation for the observed relation between management support and utilization could be that the influence of management support on utilization changes as the level of experience changes. That is, experience may act as a moderating variable on the management support to utilization relation. The work of Huff, Munro and Martin (1988) suggested that the needs and concerns of users change as the maturity of the applications developed change, supporting this interpretation.

H3: The higher the Job-Related Expectations of Personal Computer Use, the greater the Utilization of Personal Computers.

In the pilot study, the path coefficient from expectations to utilization was positive (.13) and statistically significant. In the primary study, the path coefficient for the same relation was much smaller (.03) and not significant. One possible explanation for the different results is the difference between the respondents in the two studies. Since all of the respondents from the pilot study were from the same organization, it is possible that there exists an organizational influence which was not captured in the research model.

A second possible explanation concerns the level of experience for respondents in the two studies. An examination of the frequency distributions for the three items comprising experience revealed that in general the respondents in the primary study had more experience with personal computers than those in the pilot study. It is possible that experience plays a moderating role on the relation; that is, as experience increases the influence of expectations on utilization decreases. This interpretation is consistent with the findings of Triandis (1980) discussed in chapter 2. More specifically, Triandis (1980) found that cognitive factors (such as attitudes) played a greater role in predicting behavior when experience was low, but as experience increased habit played a greater role.

H4: The greater the Correspondence Between Job Tasks and Personal Computer Use, the greater the Utilization of Personal Computers.

Correspondence was observed to have a positive influence on utilization in both the pilot and the primary study, although the effect was much larger in the second phase (.07 and .27, respectively). This implies that the greater the perceived correspondence between job tasks and the personal computer environment, the greater the utilization of personal computers. These results supported the model proposed by Goodhue (1986), and were consistent with the findings of Floyd (1986).

The difference in the magnitude of the path coefficients for the pilot and primary study may also be related to the difference in experience levels between the two groups of respondents. Another possible explanation is the potential organizational influence for the pilot study, where all respondents were from a single organization.

H5: The more positive the Beliefs About Personal Computer Usage, the greater the Utilization of Personal Computers.

The path coefficients for the relation between beliefs about personal computer usage and utilization were small for both studies (.01 and .04). Although statistically significant for the primary study, the coefficients obtained suggest that, at the very most, beliefs about usage had only a very small impact on utilization.

Again the potential influence of experience on this relation needs to be considered. It is possible that experience exerts a moderating influence here as well. Perhaps the influence of beliefs about use would be stronger for individuals who had little or no experience with personal computers.

H6: The greater the level of Personal Computer Experience, the greater the Job-Related Expectations of Using Personal Computers.

The observed path coefficients between experience and each of the components of attitudes were positive and statistically significant for both studies. The path coefficients were also relatively consistent between the two studies. This implies that experience has a strong impact on all three of the attitude components.

The relation between experience and job-related expectations was positive, with path coefficients of .21 for the pilot study and .25 for the primary study. This implies that the job-related expectations of individuals increase as they gain more experience with personal computers, but the amount of influence is not as great as the direct influence of experience on utilization.

H7: The greater the level of Personal Computer Experience, the greater the perceived Correspondence Between Job Tasks and Personal Computer Use.

The strong relation between experience and correspondence (path coefficients of .39 for the pilot study and .33 for the primary study) was also expected. Since over 80% of the respondents were in their current position more than one year, they would be expected to have a good understanding of the job tasks. As their experience with personal computers grows, they are able to see more opportunities for using personal computers for their current job responsibilities. This was consistent with the model proposed by Goodhue (1986).

H8: The greater the level of Personal Computer Experience, the more positive the Beliefs About Personal Computer Usage.

The observed relation between experience and beliefs about personal computer use was strong and positive, with path coefficients of .43 and .42 for the pilot and primary studies, respectively. This suggests that individuals who have less experience perceive the difficulties of using personal computers to be greater; again, this was as anticipated, and was consistent (albeit in a different context), with the results obtained by Rivard and Huff (1988).

H9: The greater the perceived Management Support for Personal Computing, the more positive the Job-Related Expectations of Personal Computer Use.

The relation between management support and expectations was consistent between the two studies, with path coeffieients of .14 and .12 for the pilot and primary, respectively. The results support the hypothesis that that an increased perception of management support leads to increased expectations of using personal computers for the job.

This result needs to be interpreted with caution, however. Specifically, the case for the direction of causality stated in this hypothesis is not very strong. It is possible that individuals who hold positive expectations about the use of personal computers for their job also hold positive perceptions of the support offered by management for the use of personal computers. It is possible that the results should be interpreted to support the hypothesis that a relation exists between management support and expectations, without any statement of causality.

H10: The greater the perceived Management Support for Personal Computing, the more positive the Beliefs About Personal Computer Usage.

The relation between management support and usage beliefs displayed somewhat inconsistent results. In the pilot study, the observed path coefficient was small (.02) and not statistically significant, while in the primary study the path coefficient was larger (.15) and significant. This difference in results may have been caused by the difference in the samples. More specifically, the respondents in the pilot study were all from a single organization and had all purchased personal computers for home use. It is possible that individuals who own personal computers and use them at home become more independent from the support offered by management, and hence there is less of a relation between the perception of management support and beliefs about the use of personal computers.

An alternative explanation for the relations observed between management support and the attitude components (expectations and usage beliefs) in the primary study could be that individuals with more positive attitudes toward personal computers will also have more positive perceptions of management support for personal computer use. That is, the theoretical base for the direction of the relations is not that strong; it is possible that usage beliefs and perceptions of management support co-relate, rather than one influencing the other. Each may impact the other, creating a cycle of influence (such as the one suggested by Lucas, 1978). Since the same measures were used for both constructs in the two studies, differences in measurement can be eliminated as a possible cause.

H11: The greater the Utilization of Personal Computers, the greater the perceived Job-Related Aspects of Performance.

The final relation of interest was between utilization and aspects of performance. The observed path coefficients were .53 and .49 respectively for the pilot and primary studies. The strong, positive path coefficients supported the hypothesized relation. The results from the pilot study were somewhat suspect, since a test for discriminant validity revealed that the measures for performance aspects were not able to differentiate sufficiently between utilization and performance aspects. However, the results using the revised measurement scale in the primary study also showed a strong relation, supporting the hypothesis of a relation between utilization and perceptions of performance.

The results do not include any consideration of how important the measured aspects are for any given job, however, which would be necessary before implying the magnitude of the impact on performance per se. Also, the measures for both utilization and performance were self-report. It would be expected that individuals who use personal computers to a greater extent would report increased performance. In fact, if the observed path coefficients had not been strong and positive it would have been surprising.

The purpose of this study was not the development of a model to predict utilization of personal computers. Nevertheless, if the amount of variance explained in the utilization construct was too small, it would imply that the factors found to impact utilization were themselves not very important. The R-squared values (amount of variance explained) for utilization were .33 and .38 for the pilot and primary studies respectively. Since only three of the antecedent variables were found to have a positive influence in each of the studies, the observed R-squared values suggest that these factors did in fact have significant influences on the utilization of personal computers.

There are two points concerning the interpretation of the results which need to be addressed. The first relates to the omission of potentially important factors from the conceptual model. It is recognized that the relations involving attitudes and the use of personal computer systems exist within an open system. That is, factors not included in the model (such as individual differences) may have an influence on variables which were included in the model, thus influencing the results.

The second issue relates to the use of a path analysis technique and the interpretation of the observed path coefficients. The path coefficients represent only the direct effects; not the indirect or total effects (see Pedhazur, 1982). For example, the path coefficient between experience and utilization is .43, while the correlation between the two constructs is .55. In addition to the direct effect of experience on utilization (.43), there is also the indirect effect of experience through the attitude components. By using the technique described by Pedhazur (1982), the indirect effect of experience on utilization was calculated to be .10, giving total effects of .53 (the difference between the total effect (.53) and the correlation (.55) is left unanalyzed, and is considered to be due to correlated and common causes). The indirect effects were also calculated for management support, at .01 (direct, -.09; indirect, .01; total, -.08; correlation, -.10). Since the indirect and total effects would not have changed the interpretation of the results, and would have complicated the discussion somewhat, they were excluded.

5.4 Summary of Primary Study Findings

To summarize, the general findings of the primary study were:

1. There were at least 3 distinct components of attitudes toward using personal computers; (1) job-related expectations of use, (2) correspondence between job tasks and personal computer use, and (3) beliefs about personal computer usage.

2. Experience with personal computers strongly influenced all three attitude components, and also influenced the utilization of personal computers directly.

3. Management support had a positive influence on expectations and beliefs about personal computer use. However, there was no direct relation between management support and utilization.

4. Of the attitude components, only correspondence had a strong, positive impact on personal computer utilization. The relation between usage beliefs and utilization was statistically significant, but small.

5. There was a strong relation between the utilization of personal computers and related aspects of performance.

CHAPTER 6 - CONCLUSIONS AND IMPLICATIONS

6.1 Summary of the Research Study

This study investigated the role of attitudes and beliefs in the utilization of personal computers by knowledge workers. Previous literature was examined to identify factors shown to influence utilization directly as well as indirectly. Research hypotheses were generated, and a conceptual model developed. The major contribution of the model was the separation of a high-level construct (attitudes toward personal computer use) into three components which were defined at a lower level of abstraction (expectations, correspondence, and usage beliefs).

A research instrument (questionnaire) was developed to measure the seven constructs defined in the model. For each of the constructs, measurement scales were developed. Wherever possible, previously tested measurement scales were adopted directly or adapted for the research. The completed questionnaire was pilot-tested with 216 respondents from 9 divisions of a single organization. The gross response rate for the pilot study was 62%, with a net response rate of 51%.

The data collection technique adopted for the pilot study involved an adaptation of the Total Design Method devoloped by Dillman (1978). The major difference was that the questionnaires were programmed onto computer diskettes and the respondents completed them interactively using personal computers. The method of using computer diskette-based questionnaires was termed DISKQ by Higgins, Greenwood and Dimnik (1987), who developed and tested the method.

The data obtained from the pilot study were tested with Partial Least Squares (PLS), a type of data analysis technique which was termed second generation by Fornell (1982). This technique is useful for testing a system of causal relationships (causal model), and also tests the measurement model (indicators) and structural model (hypothesized relations) simultaneously.

The results from the test of the measures used in the pilot study were satisfactory. A total of five indicators were removed from two constructs (expectations and usage beliefs) to improve the internal consistency of the measurement scales. One scale (performance aspects) was found to be inadequate with respect to discriminant validity, and was revised for the second phase of the study. In the final change to the measures, a single indicator (sophistication of use) was added to the utilization measurement scale.

The results from the test of the structural model in the pilot study generally supported the hypothesized relations, with some exceptions. Eight of eleven hypotheses were supported, and one-third of the variance was explained in the utilization construct by the model.

In the second phase of the research, the revised questionnaire was administered to 432 potential respondents in eight diverse organizations.

A total of 346 questionnaires were returned, for a gross response rate of 80%. The results from the test of the measurement model were quite satisfactory, with only one indicator exhibiting a very low factor loading. With this exception, the measures passed all tests for convergent and discriminant validity.

A number of discrepancies were noted between the results obtained from the test of the structural model in the second phase and the results from the pilot study. Possible interpretations were offered where the discrepancies existed, but in general the results were relatively consistent. In the primary study (second phase), nine of the hypothesized relations were supported. Thirty-eight percent of the variance in utilization was explained by the model.

6.2 Limitations of the Research

A number of limitations exist with this study. At the measurement level, the scale developed for one construct (beliefs about personal computer usage) was somewhat weak. In the primary study, one indicator for the same construct (UB3) displayed a low factor loading, while the remainder all had factor loadings greater than .7. This suggests that UB3 (using a personal computer can involve too much time doing mechanical operations to allow sufficient time for analysis) should be removed or revised. The remaining items, however, would provide a good base for the further development of this measurement scale.

The indicators for the usage belief construct which remained after the testing for validity and reliability measured a subset of the original construct, changing the meaning somewhat. This suggested that future work might be required to ensure the construct is defined and measured at an appropriate level of specificity (consistent with the other constructs being measured).

The measures for aspects of performance were intended for all knowledge workers, but it is clear that certain types of jobs will have more emphasis on different usage-related aspects. It might be possible to customize the measurement scale, by having supervisors and/or peers indicate those aspects which are most important for a given job position. These could then be used to match the measures of performance more closely to the specific job. In addition, it might be possible to obtain more objective measures of performance, to help investigate the relation between personal computer utilization and job performance.

At the structural level, the type of management support measured was very limited in scope. It is entirely possible that other types of support (such as the level of use by senior management and attitudes of the immediate boss) may also play a role. It would be possible develop measures for separate components of management support, just as attitudes were separated into components in this research. Also, the possibility of experience moderating the relation between management support and utilization was not anticipated and hence not included in the structural model. Further testing of the data obtained for this research and an examination of related research could lead to a modification of the conceptual model for future work.

The data for the study were collected in a cross-sectional fashion, with no longitudinal (repeated measures) component. The purpose of selecting respondents from multiple job types, with differing backgrounds and from very diverse organizations was to remove the potential for bias from factors such as organizational climate. Once the data were collected, however, it appeared that the distribution of respondents on one of the more important factors, experience, was not normal. By having a larger proportion of respondents with higher levels of experience, the variance was reduced and may have introduced a bias on some of the other factors. This may restrict the generalizability of the results somewhat, and it could be useful in future research to investigate differences (with respect to the attitudes examined here) between those who have chosen not to adopt personal computers with those who have.

Two final limitations need to be addressed. These include the time frame for the relevance of the research study, and the potential for bias to the results originating from variables which were omitted from the study.

One of the basic assumptions underlying the study is that the respondents have the option of using a personal computer, and the focus is on factors which may influence utilization and hence performance. When the study was first conceived, many managers and professionals could still choose <u>not</u> to use personal computers (or other computer systems) if they so desired. As time passes, the use of personal computers becomes less and less of an option and more of a requirement. Many employers who hire business school graduates now require that the students have a level of competence with personal computer systems. With this in mind, the research questions should now look more to the effective use of personal computers, rather than on optional use.

It was acknowledged in chapter two that individual characteristics (cognitive style, personality, demographic) could have an influence on attitudes and the use of personal computers. Reasons were given for omitting these factors from the conceptual model, but it should be noted that these factors could have some impact on the observed results for most of the measured constructs (such as the perception of management support and the threee attitude components). It might be useful to explicitly incorporate individual characteristics into future, related research.

6.3 Contributions of the Research

This research has provided a number of major contributions. The primary one relates to the original purpose of the study, which was to measure the relative strength of relations involving separate, usage-related components of attitudes. Previous research suggested that attitudes have a strong influence on utilization (Lucas, 1978; Swanson, 1982). In this study, only one of the three attitude components (correspondence) was found to have a consistently strong influence on utilization, while expectations influenced utilization for respondents in the pilot study.

This has direct implications for the type of organizational support that would have the greatest impact on the utilization of personal computers. Specifically, training aimed at increasing the awareness of individuals of potential applications of personal computer technology for their current job position will influence the perception of the correspondence between job tasks and the personal computer environment. This, in turn, could impact the utilization of personal computers.

At a more practical level, the information obtained from both the pilot and primary studies proved useful to the participating organizations. Reports showing the usage patterns and responses to open-ended questions indicated specific areas where training programs could be instituted or enhanced. Three of the organizations who had recently implemented employee purchase programs were considering expanding them, and two of the remaining companies were considering starting similar programs. Once more, the aggregated information obtained from the study provided a more concrete base for their decision making.

The identification of separate, measurable components of attitudes and beliefs within the context of system utilization is also important for researchers. With the development and testing of appropriate measurement scales, these components may now be used in future research studies. This will facilitate the investigation of the role of attitudes and beliefs in greater detail than was previously possible. In addition, there may be a sufficient amount of similarity between the use of personal computers and the use of mainframe-based information systems that the measurement scales could be adapted for use in related information systems research.

The finding of no direct relation between management support for personal computer use and the utilization of personal computers may lead to further investigation of the situation. Previous research either found or assumed that such a relationship existed. The results obtained here suggest there may be limits to the domain for the hypothesized relation. That is, the direct relation between management support and personal computer utilization may only exist under a limited set of conditions.

For practitioners, the implications are that efforts to change the utilization of personal computers by changing attitudes should emphasize the correspondence between the current job tasks and the personal computing environment. Also, the greatest influence on utilization is experience with personal computers. Combining this with the general theories of attitudes and behaviors (Petty and Cacioppo, 1981), suggests using whatever means are necessary to encourage initial use (including ready access to personal computers, mandatory training, tying personal computers into the everyday communication links, and having endorsements from very senior managers).

To encourage continued use, management should stress the potential correspondence between the job tasks and the personal computing environment. This could be facilitated through user groups, information centers with software sharing facilities, periodic application development reports, and so on. Finally, a certain level of management (technical) support is necessary, but increasing technical support will not encourage any corresponding increase in utilization(1).

6.4 Opportunities for Future Research

The topics for future research arising from this study are substantial. Some of these arise from the limitations identified earlier.

One avenue for investigation involves changing the focus of the research, and concentrating on the effective use of personal computers rather than optional use. To be more specific, increasing numbers of knowledge workers are being required to use personal computers and other computer systems as part of their jobs. However, there remains many concerns about how effectively some systems are being used, or whether they should be used at all. The important research questions now relate to the relation between the utilization of systems and performance, and the role (if any) that individual differences play in this relation.

A second area for investigation is the potential for combining studies at the organizational level (Henderson and Treacy, 1986; Huff, Munro and Martin, 1988) with this and related studies at the individual level. It

---

(1) It should be noted that the implications are based in part on the direction of relations proposed in the conceptual model. If the direction of the relation is questioned, then the implications drawn from the corresponding results should be treated with caution.

may be possible to design a research program with repeated measures at both the individual and organizational level which could investigate more thoroughly the relations between different types of management support and individual responses. By introducing repeated measures, more confidence could be placed in the direction of the observed relations.

It would also be possible to address the limitation of the study relating to the omission of other, possibly important variables such as individual characteristics (age and eduacation). This could be accomplished in conjunction with the current study, as well as with future studies relating to the effectiveness of use.

Other areas for worthwhile researcher can also be identifed, one of which was suggested by the results from the pilot study. In addition to questionnaire items required for this research, respondents were asked several questions concerning their decision to purchase a personal computer and their use of a personal computer for job-related tasks at home. Some stressed the added convenience of being able to work without physically traveling to their office; others suggested they were effectively extending their work day and decreasing the time available for their family and social contacts. This could lead to further research at the individual level, complementing existing studies such as the one conducted by Olson (1983).

From an organizational perspective, the area of employee purchase programs is also open for investigaion. At the descriptive stage, little information is known concerning the prevelance and implementation of such programs. At a different level, the implications of the programs could be explored. What might be introduced as a potential employee benefit could inadvertently result over time in expanding the scope of job positions and changing the expectations for employee productivity. On the positive side, these programs could also act as an excellent method for increasing the experience level of employees with personal computers.

One additional avenue for research relates to the finding of a strong relation between experience and utilization. This could have some influence on personnel policies within organizations, especially if a relation between utilization and performance is assumed. It would be interesting to discover the extent (if any) of such personnel changes. For example, have organizations modified their policies relating to hiring individuals, or is having personal computer experience a prerequisite for promotion to certain positions, and so on. If organizations have modified these policies to reflect the use of personal computers, it would also be interesting to monitor and examine the repercussions of such changes.

Finally, this study dealt exclusively with individuals who currently use personal computers for their job. It would be interesting to compare the attitudes and beliefs of individuals in similar jobs, who choose not to use personal computers. It is possible that attitudes and beliefs play a larger role <u>before</u> personal computer utilization is adopted, as suggested by the work of Triandis (1980).

CONCLUSION

This research study has investigated the role of attitudes and beliefs in the utilization of personal computers by knowledge workers. The factors found to influence utilization most strongly were previous computer experience with personal computers and the perception of the correspondence between job tasks and the use of personal computers. Other components of attitudes had only weak influences, and management support was not found to impact utilization directly. The research provided a number of major contributions, and implications of the results were drawn for practitioners. The study concluded with opportunities for future research arising from this work.

BIBLIOGRAPHY

Adams, C.R. "How Management Users View Information Systems", Decision Sciences, Vol. 6, 1975, pp. 337-345.

Alavi, M. "End-User Computing: The MIS Managers' Perspective", Information and Management, August, 1985, pp. 171-178.

Alavi, M. "Some Thoughts on Quality Issues of End-User Developed Systems", Proceedings of the 21st Computer Personnel Research Conference, Minneapolis, May 1985.

Alavi, M. and Weiss, I. "Managing the Risks Associated with End-User Computing", Journal of Management Information Systems, Winter 1985-86, pp. 5-20.

Ajzen, I. and Fishbein, M. "Attitude-behavior relations: A Theoretical Analysis and Review of Empirical Research", Psychological Bulletin, Vol. 84, 1977, pp. 888-918.

Amoroso, D. Effectiveness of End-User Developed Applications in Organizations: An Empirical Investigation, Unpublished Ph.D. Dissertation, The University of Georgia, Athens, Georgia, 1986.

Amoroso, D. "End-User Computing in Organizations: A Model for Investigation", Working Paper WP 86-39, The University of Western Ontario, November 1986.

Bagozzi, R. "Causal Modeling: A General Method for Developing and Testing Theories in Consumer Research", in Advances in Consumer Research, Vol. 8, pp. 195-202. Edited by K. B. Monroe. Ann Arbor, MI: Association for Consumer Research, 1982.

Bailey, J.E. and Pearson, S.W. "Development of a Tool for Measuring and Analyzing Computer User Satisfaction", Management Science, Vol. 29 (5), May 1983, pp. 530-545.

Barclay, D. The Impact of the Organization Context on Conflict in Organizational Buying: A Systems View, Unpublished Ph.D. Dissertation, The University of Michigan, 1986.

Barnett, J.M., Jr. Middle Management and the Personal Computer: an Analysis of the Effects of Personal Computer Use By Corporate Middle Managers, Unpublished Ph.D. Dissertation, Golden Gate University, 1985.

Beatty, C.A. The Implementation of Technological Change: A Field Study of Computer Aided Design", Unpublished Ph.D. Dissertation, The University of Western Ontario, London, Canada, 1986.

Beatty, W.A. Determining Factors of Microcomputer-Based Management Information System User Satisfaction, Unpublished Ph.D. Dissertation, Florida State University, 1986.

Bem, D.J. Beliefs, Attitudes and Human Affairs, Belmont, California: Brooks/Cole, 1970.

Benjamin, R.I. "Information Technology in the 1990's; A Long Range Planning Scenario", MIS Quarterly, Vol. 6 (2), June, 1982, pp. 11-31.

Benson, D.H. "A Field Study of End User Computing: Findings And Issues", MIS Quarterly, Vol. 7 (4), December, 1983, pp. 35-45.

Boomsa, A. "The Robustness of LISREL Against Small Sizes in Factor Analysis Models" in Systems Under Indirect Observation: Causality, Structure, Production, Part I, K.G. Joreskog and H. Wold (eds.), Amsterdam: North-Holland, 1982.

Bowen, W. "The Puny Payoff From Office Computers", Fortune, May 26, 1986, pp. 20-24.

Brancheau, J.C., Vogel, D.R. and Wetherbe, J.C. "An Investigation of the Information Center From the User's Perspective", Database, Fall 1985, pp. 4-17.

Bruwer, P.J.S. "A descriptive Model of Success for Computer-Based Information Systems", Information and Management, Vol. 6, 1983, pp. 63-67.

Bullen, C. "Company Experiences With End User Computing", Symposium on Computing Systems, New York University, 1985.

Burnkrant, R.E. and Page, T.J. "An Examination of the Discriminant and Predictive Validity of Fishbein's Behavioural Intention Model", Journal of Marketing Research, Vol. 19 (4), November 1982, pp. 550-561.

Campbell, D. and Fiske, D. "Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix", Psychological Bulletin, Vol. 56, March 1959, pp. 81-105.

Cheney, P.H. "Effects of Individual Characteristics, Organizational Factors and Task Characteristics on Computer Programmer Productivity and Job Satisfaction", Information and Management, July 1984, pp. 209-214.

Cheney, P., Mann, R. and Amoroso, D. "Organizational Factors Affecting the Success of End User Computing", Journal of Management Information Systems, Vol. 3(1), Summer 1986.

Cook, T.D. and Campbell, D.T. Quasi-Experimentation: Design & Analysis Issues for Field Settings, Boston: Houghton Mifflin Company, 1979.

Cronbach, L.J. "Coefficient Alpha and the Internal Structure of Tests", Psychometrika, Vol. 16, 1951, pp. 297-334.

Davis, J. A Typology of Information Systems Users and Its Implications for Effectiveness Research, Unpublished Ph.D. Dissertation, The University of Pittsburgh, 1986.

De Long, D.W. and Rockart, J.F. "A Survey of Current Trends in the Use of Executive Support Systems", CISR WP #121 and Sloan WP #1596-84, Massachusetts Institute of Technology, November 1984, 24 pages. Dijkstra, T. "Some Comments on Maximum Likelihood and Partial Least Squares Methods", Journal of Econometrics, Vol. 22, 1983, pp. 67-90.

Dijkstra, W. and van der Zouwen, J. Response Behavior in the Survey-Interview, New York: Academic Press, Inc., 1982.

Dillman, D.A. Mail and Telephone Surveys - The Total Design Method, New York: John Wiley and Sons, 1978.

Ein-Dor, P. and Segev, E. "Organizational Context and the Success of Management Information Systems", Management Science, Vol. 24 (10), June 1978, pp. 1064-1077.

Fishbein, M. "A Theory of Reasoned Action: Some Applications and Implications", in Proceedings, Nebraska Symposium on Motivation, 1979, pp. 65-116.

Fishbein, M. and Azjen, I. Belief, Attitude, Intention and Behavior, Reading, Massachusetts: Addison-Wesley, 1975.

Floyd, S. A Causal Model of Managerial Workstation Use, Unpublished Ph.D. Dissertation, The University of Colorado-Boulder, 1986.

Fornell, C. (1982 ed.), A Second Generation of Multivariate Analysis, Vol. I, Methods, New York: Praeger.

Fornell, C. "A Second Generation of Multivariate Analysis: Classification of Methods and Implications for Marketing Research", Unpublished Discussion Paper, The University of Michigan, April 1984, 43 pages.

Fornell, C. and Barclay, D. Jacknifing: A Supplement to Lohmoller's LVPLS Program, Ann Arbor, Michigan: Graduate School of Business Administration, The University of Michigan, 1983.

Fornell, C. and Larcker, D. "Evaluating Structural Equation Models with Unobservable Variable and Measurement Error", Journal of Marketing Research, Vol. 18, February 1981, pp. 39-50.

Fornell, C., Tellis, G. and Zinkhan, G. "Validity Assessment: A Structural Equations Approach Using Partial Least Squares", In AMA Educators' Proceedings, pp. 405-409. Edited by B. J. Walker et al., Chicago: American Marketing Association, 1982.

Freeman, H.E. and Shanks, J.M. (eds.), "Special Issue on the Emergence of Computer-Assisted Research", Sociological Methods and Research, Vol. 12 (2), Nov. 1983.

Fuerst, W. and Cheney, P. "Factors Affecting the Perceived Utilization of Computer-Based Decision Support Systems in the Oil Industry", Decision Sciences, Vol. 13 (4), October 1982, pp. 554-569.

Gerrity, T.P. and Rockart, J.F., "Managing End User Computing in the Information Era", CISR WP #120, Sloan WP #1595-84 , Sloan School of Management, MIT, October, 1984.

Ginzberg, M.J. "Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions", Management Science, Vol. 27 (4), April 1981, pp. 459-478.

Goodhue, D. "IS Attitudes: Toward Theoretical and Definition Clarity", Proceedings, 7th International Conference on Information Systems, San Diego, December 1986.

Greenwood, H.P., Higgins, C.A. and Dimnik, T.P. "The Micro Survey Technique", Journal of Systems Management, Vol. 38 (6), June 1987, pp. 13-19.

Guimaraes, T. "The Benefits and Problems of User Computing", Journal of Information Systems Management, Fall 1984, pp. 3-9.

Guimaraes, T. and Ramanujam, V. "Personal Computing Trends and Problems: An Empirical Study", MIS Quarterly, June 1986, pp. 179-187.

Henderson, J.C. and Treacy, M.E. "Managing End-User Computing for Competitive Advantage", Sloan Management Review, Winter 1986, pp. 3-14.

Higgins, C., Dimnik, T. and Greenwood, P. "The DISKQ Survey Method", Journal of the Market Research Society, October, 1987.

Howard, G.S. "Measurement of Managers' Attitudes Toward the Usefulness of Microcomputers: an Instrument for the MIS Researcher's Toolkit", Proceedings, AIDS Conference, Las Vegas, November 1985.

Huber. G.P. "Cognitive Style as a Basis for MIS and DSS Designs; Much Ado About Nothing", Management Science, Vol. 29 (5), May 1983, pp. 567-579.

Huff, S.L., Munro, M.C. and Martin, B.H. "Growth Stages of End User Computing", Communications of the ACM, Vol. 31 (5), May 1988, pp. 542-550.

Ives, B., Olson, M.H. and Baroudi, J.J. "The Measurement of User Information Satisfaction", Communications of the ACM, Vol. 26 (10), October 1983, pp. 785-793.

Jobber, D. and Watts, M. "Behavioural Aspects of Marketing Information Systems", Omega International Journal of Management Science, Vol. 14(1), 1986, pp. 69-79.

Joreskog, K.G. and Sorbom, D. LISREL V: Analysis of Linear Structural Relationships by Maximum Likelihood and Least Squares Methods, Chicago: National Educational Resources, 1981.

Kesper, G.M. and Cerveny, R.P., "A Laboratory Study of User Characteristics and Decision-Making Performance in End-User Computing", Information and Management, September, 1985, pp. 87-96.

Keen, P.G.W. and Woodman, L.A. "What to do with all those Micros", Harvard Business Review, Vol. 26 (5), Sept.-Oct. 1983, pp. 142-150.

Kerlinger, F.N. Foundations of Behavioral Research (second edition), Holt, Rinehart and Winston, Inc., New York, 1973.

Larcker, D.F. and Lessig, V.P. "Perceived Usefulness of Information: A Psychometric Examination", Decision Sciences, Vol. 11 (1), 1980, pp. 121-134.

Lawler, E.E. Motivation in Work Organizations, Belmont, California: Brooks/Cole, 1973.

Lee, D.M.S. "Usage Patterns and Sources of Assistance for Personal Computer Users", MIS Quarterly, December 1986, pp. 313-325.

Lietheiser, R.L. and Wetherbe, J.C. "A Survey of Information Centres: Services, Decisions, Problems, Successes", MISRC-WP-85-06, Management Information Research Center, University of Minnesota, August 1984, 33 pages.

Likert, R. "A Technique for the Measurement of Attitudes", Archives of Psychology, No. 140, 1932.

Lohmoller, J.B. LVPLS 1.6 Program Manual: Latent Variables Path Analysis with Partial Least-Square Estimation, Munich: University of the Federal Armed Forces, 1981.

Lohmoller, J.B. "An Overview of Latent Variables Path Analysis", Paper presented at the Annual Meeting of the American Educational Research Association, New York, 1982.

Lord, F.M. and Novick, M.R. Statistical Theories of Mental Tests, Reading, Massachusetts: Addison-Wesley, 1968.

Lucas, H. "Performance and the Use of an Information System", Management Science, Vol. 21(8), April 1975, pp. 908-919.

Lucas, H. "Empirical Evidence for a Descriptive Model of Implementation", MIS Quarterly, Vol. 2 (2), June 1978, pp. 27-41.

Lutz, R.J. "The role of Attitude Theory in Marketing", in Perspectives in Consumer Behavior, Kassarjian and Robertson (eds.), Glenview, Illinois: Scott, Forseman & Co., 1976, pp. 233- 250.

McLean, E.R. "End Users As Application Developers", Management Information Systems Quarterly, Vol. 3 (4), December 1979, pp. 37-46.

Moore, J.H. "Senior Executive Computer Use", Unpublished Discussion Paper, Graduate School of Business, Stanford University, 1986, 11 pages.

Morrison, P.R. "A Survey of Attitudes Toward Computers", Communications of the ACM, Vol. 26(12), December 1983, pp. 1051-1057.

Mount, J.W. "A Personal Computer in Research", American Statistical Association 1980 Proceedings of the Business and Economic Statistics Section, Washington: American Statistical Association, 1981, pp. 67-72.

Nunnally, J. Psychometric Theory (2nd ed.), New York: McGraw-Hill, 1978.

Olson, M.H. "Remote Office Work: Changing Work Patterns in Space and Time", Communications of the Acm, Vol.26 (3), March 1983), pp. 182-187.

O'Reilly, C.A. "Variations in Decision Makers' Use of Information Sources: The Impact of Quality and Accessibility of Information", Academy of Management Journal, Vol. 25 (4), December 1982, pp. 756-771.

Oskamp, S. Attitudes and Opinions, Englewood Cliffs, New Jersey: Prentice-Hall, 1977.

Pavri, F.N. An Empirical Investigation of the Factors Contributing to Microcomputer Usage, Unpublished Ph.D. Dissertation, University of Western Ontario, 1988.

Pedhazur, E.J. Multiple Regression in Behavioral Research, Holt, Rinehart and Winston, Inc., New York, 1982.

Peter, J.P. "Reliability: A Review of Psychometric Basics and Recent Marketing Practices", Journal of Marketing Research, Vol. 16, Feb. 1979, pp. 6-17.

Peter, P.J. "Construct Validity: A Review of Basic Issues and Marketing Practices", Journal of Marketing Research, Vol. 18, May 1981, pp. 133-45.

Petty, R. and Cacioppo, J. Attitudes and Persuasion: Classic and Contemporary Approaches. Dubuque, Iowa: Wm. C. Brown Company, 1981.

Popper, K.R. The Logic of Scientific Discovery, New York: Harper and Row, 1968.

Quillard, J., Rockart, J., Wilde, E., Vernon, M. and Mock, G. "A Study of the Corporate Use of Personal Computers", CISR Working Paper #109, Center for Information Systems Research, MIT, Cambridge, 1983.

Raymond, L. "Organizational Characteristics and MIS Success in the Context of the Small Business", MIS Quarterly, Vol. 9(1), March 1985, pp. 37-52.

Rivard, S. and Huff, S.L., "User Developed Applications: Evaluations of Success From the DP Department Perspective", Management Information Systems Quarterly, Vol. 8 (1), March, 1984, pp. 39-50.

Rivard, S. and Huff, S.L., "Factors of Success for End User Computing", Communications of the ACM, Vol. 31 (5), May 1988, pp. 552-561.

Robey, D. "User Attitudes and Management Information System Use", Academy of Management Journal, Vol. 22 (3), 1979, pp. 527-538.

Robey, D. "Cognitive Style and DSS Designs: A Comment of Huber's Paper", Management Science, Vol. 29 (5), May 1983, pp. 580-582.

Rockart, J.F. and Flannery, L.S. "The Management of End User Computing", Communications of the ACM, Vol. 26 (10), October 1983, pp. 776-784.

Rockart, J.F. and Treacy, M.E. "The CEO Goes On-Line", Harvard Business Review, January-February 1982, pp. 82-88.

Sawyer, A.G. and Ball, A.D. "Statistical Power and Effect Seize in Marketing Reseach", Journal of Marketing Research, Vol. 18, August 1981, pp. 275-290.

Sawyer, A.G. and Peter, J.P. "The Significance of Statistical Significance Tests in Marketing Research", Journal of Marketing Research, May 1983, pp. 122-133.

Schewe, C.D. "The MIS User: An Exploratory Behavioral Analysis", Academy of Management Journal, Vol. 19 (4), 1976, pp. 577-590.

Schultz, R.L. and Slevin, D.P. "Implementation and Organizational Validity: An Empirical Investigation", in Implementing Operations Research/Management Science, Schultz and Slevin (Eds.), pp. 153- 182, New York: American Elsevier Publishing Co., 1975.

Sink, D.S., Tuttle, T. and DeVries, S. "Productivity Measurement and Evaluation: What is Available?", National Productivity Review, Summer 1984, pp. 265-287.

Sproull, L.S. "Using Electronic Mail for Data Collection in Organizational Research", Academy of Management Journal, March 1986, pp. 159-169.

Srinivasan, A. "Alternative Measures of System Effectiveness: Associations and Implications", MIS Quarterly, Vol. 9 (3), September 1985, pp. 243-253.

Stevens, J.P. "Power of the Multivariate Analysis of Variance Tests", Psychological Bulletin, Vol. 88, Nov. 1980, pp. 728-737.

Strassman, P.A. Information Payoff: The Transformation of Work in the Electronic Age, the Free Press, New York, New York, 1985.

Sumner, M. "Organization and Management of the Information Center: Case Studies", Proceedings of the 21st Computer Personnel Research Conference, Minneapolis, May 1985.

Swanson, E.B. "Measuring User Attitudes in MIS Research: A Review", OMEGA, Vol. 10 (2), 1982, pp. 157-165.

Triandis, H. "Values, Attitudes, and Interpersonal Behavior", in H. Howe and M. Page (Eds.), Nebraska Symposium on Motivation, (Vol. 27). Lincoln: University of Nebraska Press, 1980.

Trice, A. and Treacy, M. "Utilization as a Dependent Variable in MIS Research", Proceedings, 7th International Conference on Information Systems, San Diego, December 1986.

Tukey, J. "The Jacknife", (Abstract), Annals of Mathematical Statistics, Vol. 29, 1958, pg. 614.

Vroom, V. Work and Motivation, New York: Wiley, 1964.

Wiegel, R. and Newman, L. "Increasing Attitude-behavior Correspondence by Broadening the Scope of the Behavioral Measure", Journal of Personality and Social Psychology, Vol. 33, 1976, pp. 793-802.

Werts, C., Rock, D. Linn, R. and Joreskog, K. "A General Method of Estimating the Reliability of a Composite", Educational and Psychological Measurement, Vol. 38, Winter 1978, pp. 933-938.

Whalen, B. "On-Site Computer Interviewing Yields Research Data Instantly", Marketing News, Nov. 9, 1984, pp. 1, 17.

Wildt, A.R., Lanber, Z.V. and Durand, R.M. "Applying the Jacknife Statistic in Testing and Interpreting Canonical Weights, Loadings and Cross-Loadings", Journal of Marketing Research, February 1982, pp. 99-107.

Wold, H. "Systems Analysis by Partial Least Squares", in Nijkamp, P., Leitner, H. and Wrigley, N. (1985, eds.), Measuring the Unmeasurable, Boston: Martinus Nijhoff Publishers.

Zaltman, G., LeMasters, K. and Heffring, M. Theory Constructuion in Marketing, New York: Johen Wiley & Sons, 1982. Chapter 8.

Zmud, R.W. "Individual Differences and MIS Success: A Review of the Empirical Literature", Management Science, Vol. 25 (10), October 1979, pp. 966-979.

APPENDICES

THIS PAGE LEFT

INTENTIONALLY BLANK

PARTICIPATING ORGANIZATIONS

1. E.D.S. Canada Ltd.
2. Falconbridge Ltd.
3. General Motors of Canada Ltd.
4. Menasco Aerospace Ltd.
5. Ministry of Community and Social Services
6. Ministry of Transportation
7. Northern Telecom Canada Ltd.
8. Siemens Electric Ltd.
9. Spar Aerospace Ltd.

University of Western Ontario
School of Business Administration

LETTERHEAD

Date

Dear Participant:

A growing number of individuals are using microcomputers on a regular basis. Numerous studies looking at the growth of microcomputer usage have been undertaken, but no one really knows how microcomputers affect the relationship between individuals and their work.

Your organization is one of several who have agreed to participate in this current study. In order that the results will truly reprsent the thinking of professionals within North America, it is important that each questionnaire be completed and returned. If there are any questions which you do not wish to answer, please leave them blank.

To complete the questionnaire, first load the DOS operating system onto your microcomputer (either IBM or IBM compatible) and get the "A>" prompt on your screen. Place the enclosed diskette in drive A and type "diskq" and "return", and then follow the insructions which will appear. It should take approximately thirty minutes to complete the questionnaire. When completed, place the diskette in the diskette mailer, put the mailer into the (stamped) return envelope, and drop it into the postal system. It will then be returned directly to us.

The questionnaire diskette has an identification number for mailing purposes only. This is so that we may check your name off the mailing list when your questionnaire is returned. You may be assured of <u>complete</u> <u>confidentiality</u>, as the list of names and corresponding diskette identification numbers is being held by the researchers.

The summarized results of this research will be made available to various public and private institutions. Your organization will also receive a <u>summary</u> of the results, which will be made available to you.

If you have any questions concerning the study or questionnaire, you may Ron Thompson collect at (519) 679-2111, ext. 5183. If he is unavailable, please leave a message with the Business School receptionist at (519) 661-3206 so that we may return your call.

Yours Sincerely,

Ron Thompson
Project Coordinator

Organization LETTERHEAD

Date

Respondents Name
Respondents Department

This organization feels it is important to appreciate the views of employees towards the use of microcomputers and their effect on work. For this reason we have agreed to participate in a study being conducted by the University of Western Ontario's School of Business Administration.

Since the study is being conducted by the University, no one from this organization will ever see your completed questionnaire or learn how you answered any questions. Therefore, what you say in the questionnaire will be strictly confidential. With summaries of the data gathered, we hope to learn more about your reaction to the use of microcomputers in your work.

Participation in this study is voluntary, however we are anxious to have 100% participation. We believe your ideas and views will assist us in reviewing various aspects of using microcomputers in our work.

We sincerely hope you will fully co-operate in this study.

Yours Truly,

Organization
Executive

Date

Dear Participant:

A short time ago we wrote to you seeking information on your use of microcomputers and the relationship between microcomputer use and your work. As of today we have not yet received your completed questionnaire.

We have undertaken this research study because of the belief that the information from individual professionals should be taken into account when formulating guidelines for the assistance of personal computing within organizations.

We are writing to you again because of the significance each questionnaire has to the usefulness of the study. A large number of responses have been returned, which is encouraging; the possibility always exists, however, that the opinions of those who choose not to respond are very different from those who do. For that reason it is important to us that everyone who receives a questionnaire complete and return it.

In the event that your questionnaire diskette has been misplaced, please call Ron Thompson collect at (519) 679-2111, ext. 5183 for a replacement.

Your cooperation is greatly appreciated.

Sincerely,

Ron Thompson
Project Coordinator

P.S. If you have already completed the questionnaire, please disregard this request and accept our sincere thank you.

QUESTIONNAIRE ITEMS

NOTE: The formatting of the items displayed here differs slightly from that used on the actual questionnaire diskettes. This is largely a result of taking advantage of additional features available through the use of diskette-based questionnaires. Also, only items relevant to the operationalization of the constructs have been included.

SECTION ONE - EXPERIENCE

In this section of the questionnaire we ask you a few questions concerning your use of microcomputers.

EX1. How long have you used a microcomputer for job-related work?

1 I DO NOT USE A MICROCOMPUTER FOR JOB-RELATED WORK

2 0 - 2 MONTHS

3 3 - 5 MONTHS

4 6 - 8 MONTHS

5 9 - 12 MONTHS

6 MORE THAN 12 MONTHS

EX2. Compared with others in your organization who have jobs similar to yours, how well can you type on a microcomputer keyboard?

VERY POORLY		AVERAGE		VERY WELL
1	2	3	4	5

EX3. Overall, how would you rate your microcomputer skills?

NOVICE		AVERAGE		EXPERT
1	2	3	4	5

SECTION TWO - MANAGEMENT SUPPORT

In this section of the questionnaire we wish to obtain your opinions concerning the support offered by your organization, with respect to the introduction and use of microcomputers. Please tell us how much you agree or disagree with the following statements by indicating the most appropriate response.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

	STRONGLY DISAGREE				STRONGLY AGREE
MS1. Guidance is available to me in the selection of hardware, software, printers, other equipment......	1	2	3	4	5
MS2. A specific person (or group) is available for assistance with software difficulties.............	1	2	3	4	5
encounter difficulties with my microcomputer.......	1	2	3	4	5
MS3. Specialized instruction and education concerning the popular software is available to me...........	1	2	3	4	5
MS4. A specific person (or group) is available for assistance with hardware difficulties.............	1	2	3	4	5
MS5. In general, I feel the organization has been very supportive in the introduction of microcomputers...	1	2	3	4	5

SECTION THREE- EXPECTATIONS

The following questions deal with whether you think your job or other aspects of your life may be changed by using a microcomputer, and if so, how. There might be more issues listed than you have thought about; many have been included because the researchers believe that different issues are probably important to different individuals.

Please indicate below whether you think that using a microcomputer will increase each aspect of your job. If you believe there will be a decrease or no increase at all, indicate 'To a Very Little Extent'.

TO A VERY LITTLE EXTENT	TO A LITTLE EXTENT	TO SOME EXTENT	TO A GREAT EXTENT	TO A VERY GREAT EXTENT
1	2	3	4	5

I THINK THAT USING A MICROCOMPUTER WILL INCREASE:

EP1. the level of challenge on my job	1	2	3	4	5
EP2. the opportunity for future job assignments I prefer	1	2	3	4	5
EP3. my status	1	2	3	4	5
EP4. my control over my own job	1	2	3	4	5
EP5. the communication in my department	1	2	3	4	5
EP6. the amount of variety in my job	1	2	3	4	5
EP7. the opportunities for more meaningful work	1	2	3	4	5

SECTION FOUR - CORRESPONDENCE

In this section we would like you to think of the job tasks which are required for your CURRENT position. Considering also your understanding of a microcomputer system, please tell us how much you agree or disagree with the following statements by indicating the appropriate response.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

FOR MY CURRENT POSITION, USE OF A MICROCOMPUTER COULD:

	STRONGLY DISAGREE				STRONGLY AGREE
C01. substantially decrease the time needed to perform my important job responsibilities.........	1	2	3	4	5
C02. significantly increase the quality of output of my job..	1	2	3	4	5
C03. substantially increase the effectiveness with which job tasks are performed (eg. evaluating alternatives, producing information, etc.)........	1	2	3	4	5
C04. significantly increase the quantity of output for the same amount of effort....................	1	2	3	4	5

C05. Now considering all of the tasks and functions you perform on your job, (producing reports, communicating with others, etc.), to what extent do you believe the use of microcomputers could (or does) assist you on your job?

TO A VERY LITTLE EXTENT	TO A LITTLE EXTENT	TO SOME EXTENT	TO A GREAT EXTENT	TO A VERY GREAT EXTENT
1	2	3	4	5

SECTION FIVE - USAGE BELIEFS

The following statements represent possible feelings of individuals toward microcomputers. We would like you to indicate how strongly you agree or disagree with each.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

	STRONGLY DISAGREE				STRONGLY AGREE
UB1. Using a microcomputer takes too much time from my normal duties	1	2	3	4	5
UB2. Microcomputers make work more interesting	1	2	3	4	5
UB3. Working with microcomputers is so complicated, it is difficult to understand what is going on	1	2	3	4	5
UB4. Using a microcomputer can involve too much time doing mechanical operations (programming, inputting data, etc.) to allow sufficient time for analysis	1	2	3	4	5
UB5. Working with microcomputers is fun	1	2	3	4	5
UB6. Using a microcomputer can provide me with information that will lead to better decisions	1	2	3	4	5
UB7. It takes too long to learn how to use a microcomputer to make it worth the effort	1	2	3	4	5

SECTION SIX - UTILIZATION

UT1. On average, how much time do you spend per day using a microcomputer at your OFFICE for job-related work?

1 0 - 15 MINUTES

2 16 - 30 MINUTES

3 30 - 45 MINUTES

4 45 - 60 MINUTES

5 60 - 120 MINUTES

6 MORE THAN 120 MINUTES

UT1. On average, how much time do you spend per day using a microcomputer at HOME for job-related work?

1 0 - 15 MINUTES

2 16 - 30 MINUTES

3 30 - 45 MINUTES

4 45 - 60 MINUTES

5 60 - 120 MINUTES

6 MORE THAN 120 MINUTES

UT2. On average, how FREQUENTLY do you use a microcomputer? (Please include both home and office use).

1 SEVERAL TIMES PER DAY

2 ABOUT ONCE PER DAY

3 ONCE OR TWICE PER WEEK

4 ONCE OR TWICE PER MONTH

5 LESS THAN ONCE PER MONTH

UTILIZATION UT3. (composite score - sum of packages used 'To Some Extent' or more - 3, 4 or 5 on a 5-point Likert type scale).

To what extent do you currently use the following microcomputer packages? (Please indicate the most appropriate number - if you use a package very little or not at all, indicate 'To A Very Little Extent').

	TO A VERY LITTLE EXTENT	TO A LITTLE EXTENT	TO SOME EXTENT	TO A GREAT EXTENT	TO A VERY GREAT EXTENT
	1	2	3	4	5
CURRENT USE OF:					
— SPREADSHEET (eg. Lotus 1-2-3)..	1	2	3	4	5
— WORD PROCESSING (eg. Samna)..	1	2	3	4	5
— DATABASE (eg. DBASE III)..	1	2	3	4	5
— STATISTICAL ANALYSIS................	1	2	3	4	5
— COMMUNICATIONS (eg. CROSSTALK)..	1	2	3	4	5
— PROGRAM APPLICATIONS (eg. FORTRAN)..	1	2	3	4	5
— GRAPHICS..........................	1	2	3	4	5
— OTHER OFF-THE-SHELF PACKAGES........	1	2	3	4	5

SECTION SEVEN - PERFORMANCE ASPECTS

Please consider your experience with your microcomputer to date, and indicate how much you agree or disagree with the following statements.

PA1. It has been useful for performing my current job responsibilities.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

PA2. It has improved my writing skills (eg., the quality and quantity of my reports, correspondence, etc.).

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

PA3. It has allowed me to communicate more effectively with others (for example, with electronic mail).

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

PA4. Owning a microcomputer has increased my reliance on microcomputers in my work.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

QUESTIONNAIRE ITEMS

NOTE: The formatting of the items displayed here differs slightly from that used on the actual questionnaire diskettes. This is largely a result of taking advantage of additional features available through the use of diskette-based questionnaires. Also, only items relevant to the operationalization of the constructs have been included.

SECTION ONE - EXPERIENCE

In this section of the questionnaire we ask you a few questions concerning your use of microcomputers.

EX1. How long have you used a microcomputer for job-related work?

1 0 - 3 MONTHS

2 4 - 7 MONTHS

3 8 - 12 MONTHS

4 13 - 24 MONTHS

5 MORE THAN 24 MONTHS

6 I DO NOT USE A MICROCOMPUTER FOR JOB-RELATED WORK

EX2. Compared with others in your organization who have jobs similar to yours, how well can you type on a microcomputer keyboard?

VERY POORLY		AVERAGE		VERY WELL
1	2	3	4	5

EX3. Overall, how would you rate your microcomputer skills?

NOVICE		AVERAGE		EXPERT
1	2	3	4	5

SECTION TWO - MANAGEMENT SUPPORT

In this section of the questionnaire we wish to obtain your opinions concerning the support offered by your organization, with respect to the introduction and use of microcomputers. Please tell us how much you agree or disagree with the following statements by indicating the most appropriate response.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

	STRONGLY DISAGREE				STRONGLY AGREE
MS1. Guidance is available to me in the selection of hardware, software, printers, other equipment......	1	2	3	4	5
MS2. A specific person (or group) is available for assistance with software difficulties.............	1	2	3	4	5
encounter difficulties with my microcomputer.......	1	2	3	4	5
MS3. Specialized instruction and education concerning the popular software is available to me...........	1	2	3	4	5
MS4. A specific person (or group) is available for assistance with hardware difficulties.............	1	2	3	4	5
MS5. In general, I feel the organization has been very supportive in the introduction of microcomputers...	1	2	3	4	5

SECTION THREE- EXPECTATIONS

The following questions deal with whether you think your job or other aspects of your life may be changed by using a microcomputer, and if so, how. There might be more issues listed than you have thought about; many have been included because the researchers believe that different issues are probably important to different individuals.

Please indicate below whether you think that using a microcomputer will increase each aspect of your job. If you believe there will be a decrease or no increase at all, indicate 'To a Very Little Extent'.

TO A VERY LITTLE EXTENT	TO A LITTLE EXTENT	TO SOME EXTENT	TO A GREAT EXTENT	TO A VERY GREAT EXTENT
1	2	3	4	5

I THINK THAT USING A MICROCOMPUTER WILL INCREASE:

EP1. the level of challenge on my job............	1	2	3	4	5
EP2. the opportunity for future job assignments I prefer....................................	1	2	3	4	5
EP3. my status....................................	1	2	3	4	5
EP6. the amount of variety in my job............	1	2	3	4	5
EP7. the opportunities for more meaningful work....................................	1	2	3	4	5

SECTION FIVE - USAGE BELIEFS

The following statements represent possible feelings of individuals toward microcomputers. We would like you to indicate how strongly you
agree or disagree with each.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

	STRONGLY DISAGREE				STRONGLY AGREE
UB1. Using a microcomputer takes too much time from my normal duties	1	2	3	4	5
UB3. Working with microcomputers is so complicated, it is difficult to understand what is going on	1	2	3	4	5
UB4. Using a microcomputer can involve too much time doing mechanical operations (programming, inputting data, etc.) to allow sufficient time for analysis	1	2	3	4	5
UB7. It takes too long to learn how to use a microcomputer to make it worth the effort	1	2	3	4	5

SECTION FOUR - CORRESPONDENCE

In this section we would like you to think of the job tasks which are required for your CURRENT position. Considering also your understanding of a microcomputer system, please tell us how much you agree or disagree with the following statements by indicating the appropriate response.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

FOR MY CURRENT POSITION, USE OF A MICROCOMPUTER COULD:	STRONGLY DISAGREE				STRONGLY AGREE
C01. substantially decrease the time needed to perform my important job responsibilities.........	1	2	3	4	5
C02. significantly increase the quality of output of my job......................................	1	2	3	4	5
C03. substantially increase the effectiveness with which job tasks are performed (eg. evaluating alternatives, producing information, etc.)........	1	2	3	4	5
C04. significantly increase the quantity of output for the same amount of effort....................	1	2	3	4	5

C05. Now considering all of the tasks and functions you perform on your job, (producing reports, communicating with others, etc.), to what extent do you believe the use of microcomputers could (or does) assist you on your job?

TO A VERY LITTLE EXTENT	TO A LITTLE EXTENT	TO SOME EXTENT	TO A GREAT EXTENT	TO A VERY GREAT EXTENT
1	2	3	4	5

SECTION SEVEN - PERFORMANCE ASPECTS

In this section of the questionnaire we ask you to consider your experience with microcomputers to date. We would like you to think about the statements separately, and indicate how much you agree or disagree with each. Please keep in mind we are interested in those things which you believe HAVE happened, rather than those you believe MIGHT happen.

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5

USING A MICROCOMPUTER HAS:	STRONGLY DISAGREE				STRONGLY AGREE
PA1. improved the quality of the reports which I produce	1	2	3	4	5
PA2. reduced the time required to perform my more routine job tasks	1	2	3	4	5
PA3. allowed me to communicate more effectively with others	1	2	3	4	5
PA4. improved my writing skills (letters, memos, reports, other)	1	2	3	4	5
PA5. reduced my reliance on other individuals within the organization	1	2	3	4	5
PA6. improved the quality of the analysis which I perform	1	2	3	4	5
PA7. allowed me to use more creativity in dealing with different aspects of my job	1	2	3	4	5

SECTION SIX - UTILIZATION

UT1. On average, how much time do you spend per day using a microcomputer at your OFFICE for job-related work?

1 0 - 15 MINUTES

2 16 - 30 MINUTES

3 30 - 45 MINUTES

4 45 - 60 MINUTES

5 60 - 120 MINUTES

6 MORE THAN 120 MINUTES

UT1. On average, how much time do you spend per day using a microcomputer at HOME for job-related work?

1 0 - 15 MINUTES

2 16 - 30 MINUTES

3 30 - 45 MINUTES

4 45 - 60 MINUTES

5 60 - 120 MINUTES

6 MORE THAN 120 MINUTES

UT2. On average, how FREQUENTLY do you use a microcomputer? (Please include both home and office use).

1 SEVERAL TIMES PER DAY

2 ABOUT ONCE PER DAY

3 ONCE OR TWICE PER WEEK

4 ONCE OR TWICE PER MONTH

5 LESS THAN ONCE PER MONTH

UTILIZATION - UT3. (composite score - sum of packages used 'To Some Extent' or more - 3, 4 or 5 on a 5-point Likert type scale).

To what extent do you currently use the following microcomputer packages? (Please indicate the most appropriate number - if you use a package very little or not at all, indicate 'To A Very Little Extent').

TO A VERY LITTLE EXTENT	TO A LITTLE EXTENT	TO SOME EXTENT	TO A GREAT EXTENT	TO A VERY GREAT EXTENT
1	2	3	4	5

CURRENT USE OF:

— SPREADSHEET (eg. Lotus 1-2-3)..	1	2	3	4	5
— WORD PROCESSING (eg. Samna)..	1	2	3	4	5
— DATABASE (eg. DBASE III)..	1	2	3	4	5
— STATISTICAL ANALYSIS................	1	2	3	4	5
— COMMUNICATIONS (eg. CROSSTALK)..	1	2	3	4	5
— PROGRAM APPLICATIONS (eg. FORTRAN)..	1	2	3	4	5
— GRAPHICS...........................	1	2	3	4	5
— OTHER OFF-THE-SHELF PACKAGES........	1	2	3	4	5

UTILIZATION - UT4; also a composite score - 3, 4 or 5 on a 5-point Likert type scale).

We are also interested in learning about the types of job tasks for which you use microcomputers. Please indicate to what extent you currently use a microcomputer for the following applications (if you do not use a microcomputer for the application, please indicate 'To A Very Little Extent').

	TO A VERY LITTLE EXTENT	TO A LITTLE EXTENT	TO SOME EXTENT	TO A GREAT EXTENT	TO A VERY GREAT EXTENT
	1	2	3	4	5
CURRENTLY USE MICROCOMPUTER FOR:					
— LETTERS AND MEMOS..................	1	2	3	4	5
— ELECTRONIC COMMUNICATIONS..........	1	2	3	4	5
— REPORTS - PRIMARILY TEXT...........	1	2	3	4	5
— REPORTS - PRIMARILY NUMERICAL.......	1	2	3	4	5
— BUDGETING..........................	1	2	3	4	5
— OTHER FINANCIAL ANALYSIS...........	1	2	3	4	5
— PLANNING/FORECASTING...............	1	2	3	4	5
— DATA STORAGE/RETRIEVAL (MICRO ONLY).	1	2	3	4	5
— DATA STORAGE/RETRIEVAL (THROUGH COMMUNICATION WITH OTHER SYSTEMS)...	1	2	3	4	5
— ENGINEERING APPLICATIONS (IE. CAD)..	1	2	3	4	5
— OTHER..............................	1	2	3	4	5

Descriptive Results for Measurement Items
(see Appendix VII for response values/scales)

Construct/Measure	Mean	Std. Dev.	Skewness
Experience			
EX1	N/A		
EX2	3.4	1.2	-.15
EX3	3.2	1.1	-.37
Management Support			
MS1	3.5	1.3	-.66
MS2	3.8	1.3	-.98
MS3	3.6	1.2	-.67
MS4	3.9	1.2	-1.00
MS5	3.9	1.2	-.96
Expectations			
EP1	3.3	1.2	-.43
EP2	3.1	1.3	-.14
EP3	2.7	1.1	.13
EP6	2.9	1.2	-.08
EP7	3.1	1.2	-.25
Correspondence			
CO1	3.9	1.3	-.99
CO2	4.1	1.1	-1.46
CO3	4.1	1.0	-1.34
CO4	4.1	1.0	-1.32
CO5	4.0	.9	-.77
Usage Beliefs			
UB1	1.7	1.0	1.32
UB3	1.5	.9	1.70
UB4	2.5	1.1	.30
UB7	1.7	1.0	1.72
Utilization			
UT1	N/A		
UT2	N/A		
UT3	N/A		
UT4	N/A		
Performance Aspects			
PA1	4.1	1.1	-1.23
PA2	3.7	1.0	-.63
PA3	3.4	1.1	-.39
PA4	3.3	1.2	-.25
PA5	3.4	1.1	-.27
PA6	3.6	1.0	-.63
PA7	3.7	1.0	-1.00

Descriptive Results for Measurement Items

Experience	Response	Percent
EX1	1	10.7
	2	7.8
	3	6.8
	4	20.5
	5	52.2
	6	2.0
Utilization		
UT1	1	8.1
	2	8.6
	3	12.0
	4	13.9
	5	33.0
	6	12.0
	7	4.8
	8	5.3
	9	0.5
	10	1.9
UT2	1	39.7
	2	37.8
	3	5.3
	4	12.4
	5	4.8
UT3	1	6.2
	2	16.7
	3	24.4
	4	19.1
	5	15.8
	6	10.0
	7	5.7
	8	1.4
	9	0.5
UT4	1	4.8
	2	9.6
	3	13.4
	4	17.2
	5	19.6
	6	9.6
	7	9.1
	8	10.5
	9	4.8
	10	1.4